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CANADIAN ELECTRONICS ENGINEERING

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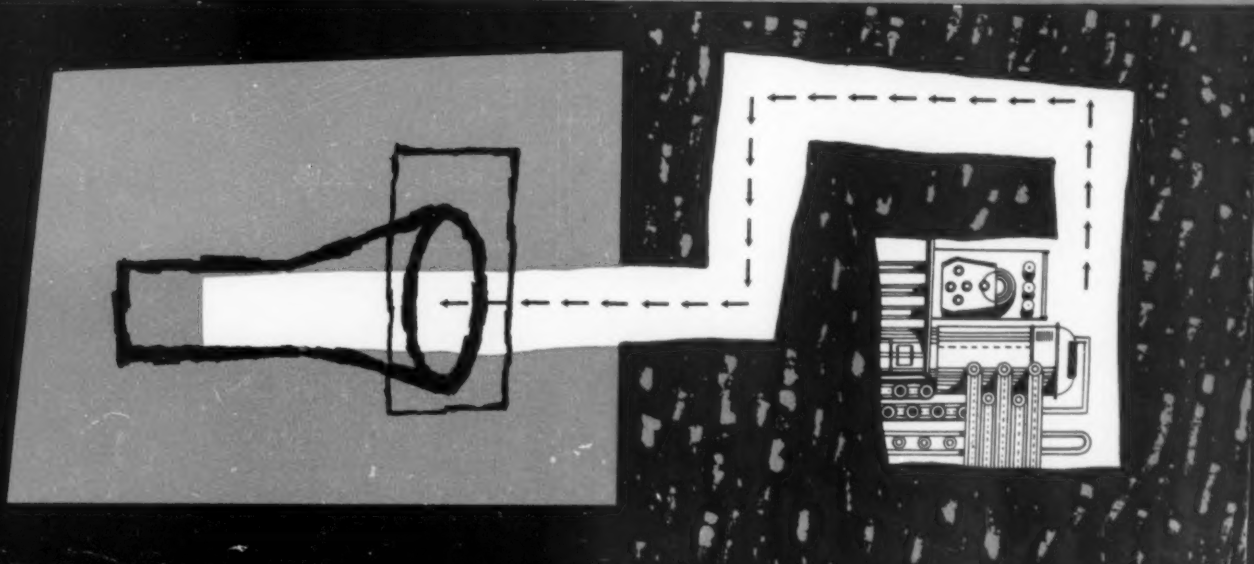

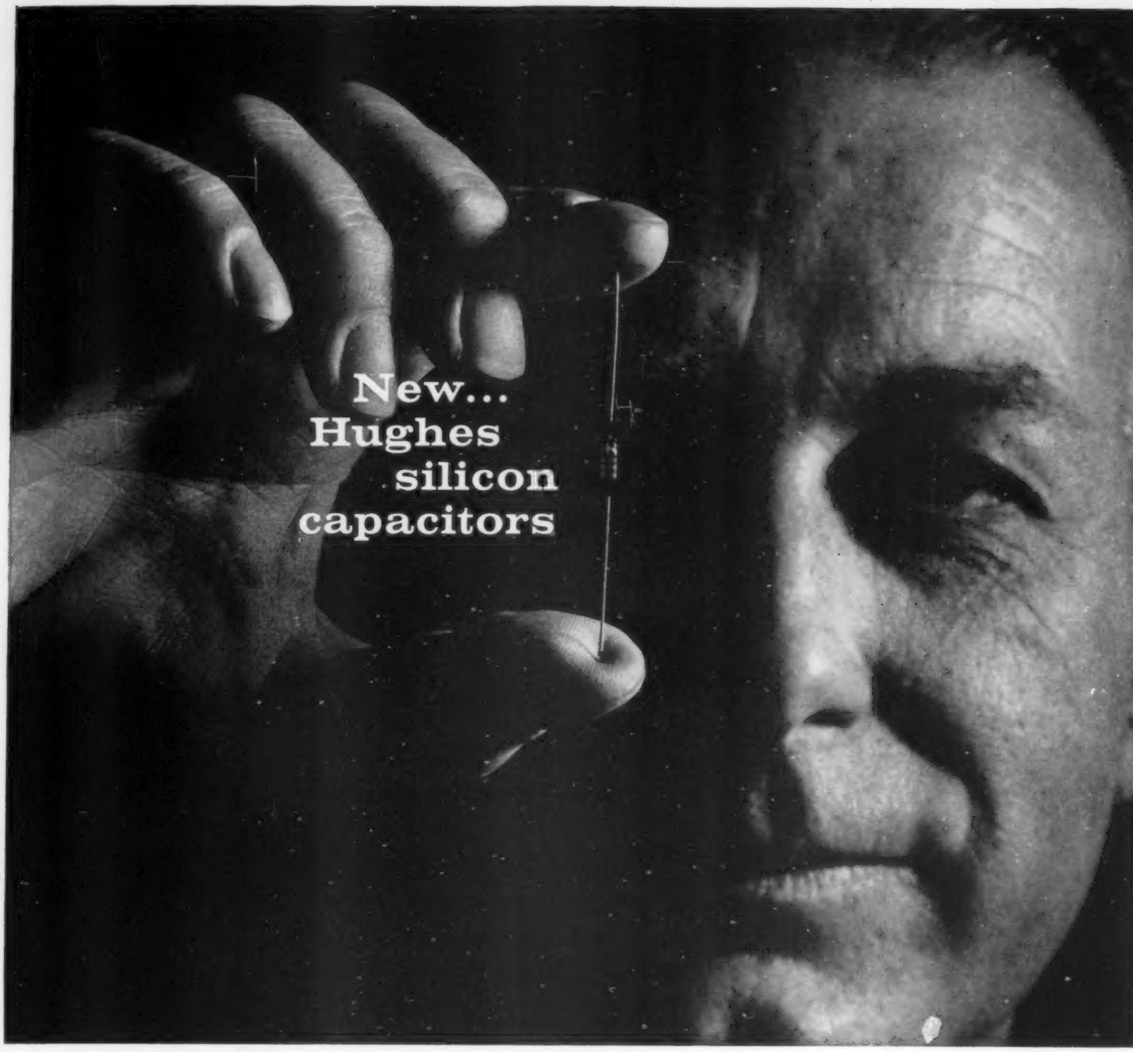

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This is a practical series of new components; capacitors whose capacitance is determined by the applied DC voltage. The Q is high and the capacity range, great. For the first time, circuits can be tuned by electrical rather than mechanical methods.

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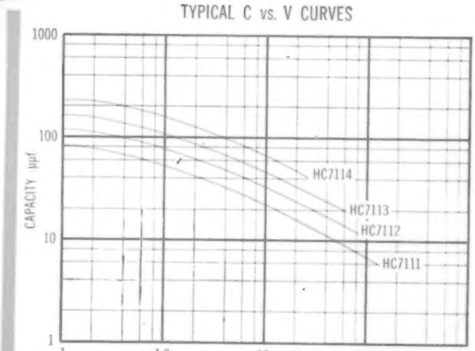
SPECIFICATIONS

Type	Capacity @ −4VDC ± 20% (μμf)	Typical Capacity Range (μμf)	Voltage Range Over Which Capacity Is Varied (VDC)	Typical Q @ 25Mc and Maximum Voltage
HC7111	35	6- 90	0.1-130	75
HC7112	50	12-120	0.1- 80	70
HC7113	70	20-170	0.1- 60	58
HC7114	100	44-240	0.1- 25	43

TYPICAL C vs. V CURVES



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HUGHES PRODUCTS

HUGHES
SEMICONDUCTORS

April 1958

Volume two, number 4

CANADIAN ELECTRONICS ENGINEERING

Departments

***our cover design** *With so many possible applications for industrial television, our cover artist this month selected a few ideas and added them together into an abstract interpretation*

CANADIAN ELECTRONICS ENGINEERING

staff

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contributors and special articles in this issue:

The author of the second article on technical writing, **Jack Konigsberg** (Expanding the role of the engineering writer), has gathered his information the hard way. For the past two years he has been senior engineering writer with the research and development division of Mergenthaler Linotype Co., Brooklyn. Prior to that, he spent five years with Illustrated Technical Products Corp. writing instruction books on electronic equipment.

The rest of his life appears to have been spent studying. He has a B.A. in liberal arts, an M.A. in mathematics, and is currently studying electrical engineering at the Polytechnic Institute of Brooklyn.

Jack is a New York cliff dweller, is married with one daughter and one son. Both were taught to write before they could walk or talk.

Trevor W. Denzey (Twin-deck system replaces two-sided printed circuit boards) has enjoyed a wide variety of experiences. He gained most of his electronic training in the Royal Navy, which he joined in 1940 as a telegraphist. Later he graduated from the RN College as a sub-lieutenant and supervised radar installation and training at various points in the Middle East. In 1942 he was concerned with the first radar installation in a submarine.

After nine years' postwar industrial development work in England, he joined CGE's airborne radar group in 1955. Since 1956 he has been running his own operation at Oakville — a subsidiary of Photo Color Process Corporation. Products include printed circuit boards, nameplates and custom engraving.

Following our Industry Review and Forecast in January, which took an overall look at the Canadian electronics industry, editor Harold Price presents a closer look at one section of the market. His thanks are extended to the many companies who provided photos and information.

CCTV — or industrial television, as it is sometimes called, is enjoying a lot of publicity these days but sales so far are not proportionate. The long-term outlook, however, is much brighter.

See pages 16-21 for the first of a series of market reports we plan to publish in coming issues. Reader suggestions of potential subjects for this series will naturally be given our serious consideration.

It is interesting to note the number of Englishmen working in the atomic energy field. **V. Allen** (Transistorized slow neutron monitor uses proportional counter) was born in London. After a stint in the Royal Signals he entered London University and received his degree, B.Sc.(Eng.), in 1951. At the Post Office Research Station in London he worked on the analysis and synthesis of speech with a view to reducing the information capacity required of telecommunication channels. This ended in 1956 when he came to A.E.C.L. in Chalk River to design instruments for use in nuclear research.

Allen

a Maclean-Hunter publication

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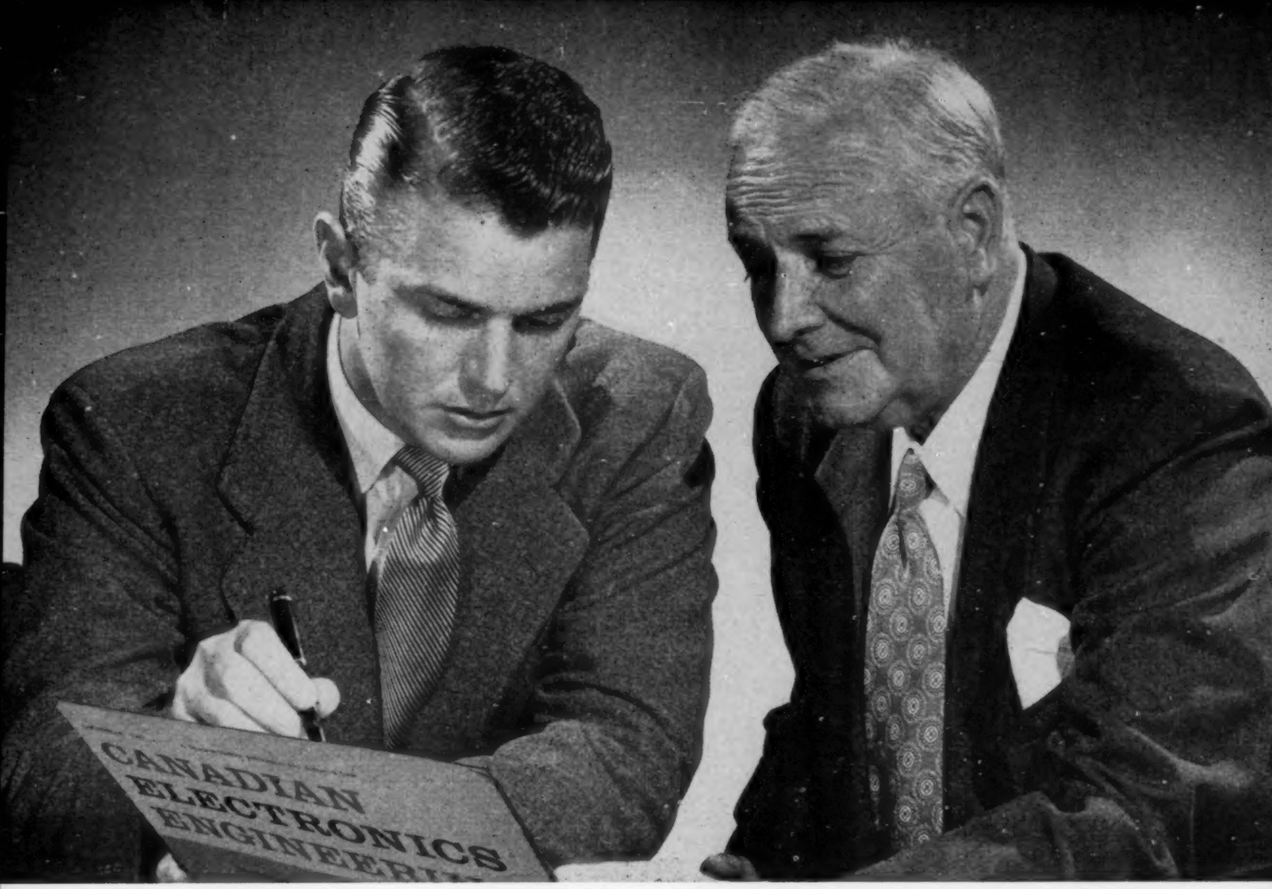

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COMPONENTS AND EQUIPMENT DIRECTORY"

Here's big news! In June, Canada's electronic engineers will be provided with an authoritative record of sources supplying electronic components and equipment.

The COMPONENTS AND EQUIPMENT DIRECTORY — to be published by Canadian Electronics Engineering — will list hundreds of manufacturers and suppliers under headings that will include every known product of use to the electronics industry. Its contents — carefully compiled by experts—will be the most up-to-date anywhere.

Designed as a year 'round buying guide, the COMPONENTS AND EQUIPMENT DIRECTORY represents one of the year's best advertising buys. More than 8,400 copies will be distributed to electronic engineers in management, research, design and application . . . and the listings of advertisers will be specially marked to draw attention to their advertised products.

Don't miss this splendid sales opportunity. Reserve dominant advertising space now to assure the best possible position.

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A MACLEAN-HUNTER PUBLICATION

Serving the electronic and communications industry — in management, research, design and application

News highlights . . .

Missile intercepts — $1.25 a piece . . .

DRB scientists are carrying out 40,000 simulated interceptions of enemy bombers by guided weapons during 200 hours' rental of an IBM 704 computer. Cost: $50,000. Estimated cost of 40,000 full-scale missile trials: $5 billion!

Trans-Atlantic TV in 10 years . . .

Dr. R. G. Griffith, chief engineer of Canadian Overseas Telecommunication Corporation, has confidently forecast successful trans-Atlantic television within the next ten years. He said COTC and a large Canadian company are both working on the problem, in addition to U.S. and U.K. organizations.

Westinghouse gets big contract . . .

From mid-January to mid-February the Department of Defence Production awarded unclassified electronics contracts for $10,000 or more worth around $1,200,000. Largest at $830,000 was to Canadian Westinghouse for the installation of an instrumentation system.

Soviet trade in Europe . . .

Despite political differences, the U.S.S.R. still purchases about one third of its imports of machines and industrial equipment this side of the iron curtain. Recent example of return flow of trade: French purchase of large consignment of radio receivers from Latvia.

Private TV in major centres . . .

Spokesmen for private television stations believe new Parliament will review Fowler report later this year, including its recommendation for the establishment of a regulatory body independent of the CBC and the setting up of private stations in major centres.

Misemployment of engineers . . .

"There has never been a crippling shortage of professional engineers in this country, but we have been guilty of misemployment of the engineering brains that have been available," says Col. T. M. Medland, APEO executive director, in his annual report. He underlined the need for more technician and clerical assistance to engineers in industry.

RETMA: Radio week and TV week . . .

In connection with Radio Week (May 4-10), RETMA of Canada will be providing 300 free radios for distribution by the CARTB to member stations throughout Canada as prizes for contest promotions.

RETMA will also support Canadian Television Week, to be held September 21-27, 1958.

Total radio receiver distributor sales to dealers in January 1958 were 30,158 units (January 1957 — 44,623). Figures for television receivers were: January 1958 — 33,735 (January 1957 — 39,426).

New member of the Components Division is Emanuel Products Ltd., 969 Weston Road, Toronto. They manufacture radio, television, combination and hi-fi cabinets and television bases.

People in the industry

DRB looks to the future, appoints Arnell director of plans

The Defence Research Board has appointed **Dr. C. Arnell** as Director of Plans. This is a new directorate within DRB Headquarters established to coordinate and present information bearing on the Board's long-term planning program. The directorate will also be responsible for foreign and domestic liaison. Dr. Arnell began his new duties early in March.

Due to the rapid development internationally of new weapons, creation of the new directorate was dictated by the need for even more detailed long-term planning than had been maintained in the past. As many aspects of this planning are closely dependent on the research programs of friendly countries, the Board's increased cooperation with them has necessitated the strengthening of the liaison staff.

A native of Halifax, N.S., Dr. Arnell won a B.Sc. with high honours in chemistry at Dalhousie in 1939. At the same university the following year, he obtained a master's degree in physical chemistry and in 1942, his doctorate in the same field at McGill.

After a period with the Canadian Army as a technical staff officer in the Chemical Warfare Laboratories, Dr. Arnell continued as a civilian at CWL. He became superintendent in 1949 after the establishment was taken over by DRB. Early in 1954 he was appointed Senior Scientific Officer (Special Weapons) at DRBHQ, and a year later was named Director of Scientific Intelligence.

Rosso and McNeil

Dr. Arnell will be succeeded by **Harold Larnder,** OBE, 55, leader of a small group of World War 2 scientists who developed operational research in the United Kingdom as a new scientific specialty. As a member of the Board staff since 1951, Mr. Larnder has carried out a variety of operational research duties in senior capacities, most recently as Director of the RCAF Directorate of Systems Evaluation.

Born in England but educated in Canada, Mr. Larnder enjoys the distinction of having been a member of Sir Robert Watson-Watt's original radar research team. For his personal contribution in this field, along with Sir Robert and his associates, he was the recipient of a substantial financial award granted in 1951.

CGE welcomes South American visitor

Broadcast sales manager for General Electric of Venezuela, **Arrigo Rosso,** 35, made a flying trip to Toronto recently to inspect CGE's new 50 kw a-m radio broadcast transmitter. Mr. Rosso has sold one of the transmitters to Radio Caracas, the government-owned radio station in Venezuela.

Before emigrating to Venezuela, Mr. Rosso was in charge of radio installations for the BBC at Udine, in Northern Italy. He was a radio amateur, call sign I-1-S-Z, and had talked with operators in Canada and the U.S. "I had planned to emigrate here," he commented, "but I was told there were great opportunities for technically-trained men in Venezuela." He said that there is still a great need for such men, since the country is expanding very rapidly.

Before flying back he was interviewed by **Bill McNeil,** host on CBC's Dominion network show "Assignment," when he described the radio and TV system in Venezuela.

Fellows moves to Tele-Radio

Increased activity in telephone equipment sales has led to the appointment of a new sales manager at Tele-Radio Systems Ltd. **John A. Fellows,** formerly manager of the telephone equipment division of Pye Canada Ltd., will be responsible for liaison with the independent telephone companies in Canada.

Senior posts filled at Canadian Motorola

R. M. Brophy, president of Canadian Motorola Electronics Limited, Toronto, following the recent announcement of the completion of a long-term sales and manufacturing agreement with Motorola Inc., Chicago, has released details of senior appointments in the company.

G. W. Crossan, formerly marketing manager, becomes sales manager — mobile communications. **H. M. Reid,** formerly Ontario region manager, becomes marketing manager — mobile communications. **W. H. Galpin** will function as product manager and **G. H. Dickson** fills the position of national service manager.

Crossan

Reid

Canadian Westinghouse adds to board

The election of the **Hon. Leon Methot,** QC, BA to the board of directors of the Canadian Westinghouse Company, Limited has been announced by George L. Wilcox, president. Appointed to the Senate of Canada in October, 1957, he is a native of Trois Rivieres, Que., where he still resides and conducts an extensive legal practice.

CESCO promotes two, adds one

M. I. Rosenthal, president of Canadian Electrical Supply Company Ltd., Montreal, has announced the appointment of **Robert Villiard** and **Joseph Pascal** as vice-presidents of the company, and of **Danny Fitzmorris** as industrial sales representative for the company's industrial division.

Mr. Villiard has 14 years' experience with Cesco, broken only by a spell in the RCAF as a commissioned navigator and later as a POW in Germany. He has had broad radio experience in various positions, most recently as the company's Montreal branch manager.

Joe Pascal has been in the electronics business for 30 years, 18 of them with Cesco. He is now co-ordinator of the four branches, as well as industrial manager and supervisor of purchasing.

Previously with Century Electric and Canadian Marconi, Mr. Fitzmorris brings to Cesco a total of 14 years in the electronics industry.

Reports from the industry

Northern Electric sees upswing—plans new factory near London

Anticipating a healthy rise in the volume of electronics business in the near future, Northern Electric Co. has taken first steps towards a $12,000,000 factory in Westminster Township, Ontario. The plant will be used to manufacture communications equipment and will employ up to 1,000 people.

Plans for the new building are well under way stated H. Miller, engineer in charge of plant location and real estate. It will be situated on 100 acres with easy access to London and to a main arterial route across the province.

Production starts at Edo plant

Underwater detection equipment for the Royal Canadian Navy is now being made at the new Edo (Canada) Ltd. plant in Cornwall, Ontario. Production commenced on a limited scale ten months after sod was turned for the factory.

The company produces sonic equipment for underwater mapping and detection. They also make radar and loran for navigation.

Automatic Electric will handle Panhandle fm equipment

Panhandle Electric Sales fm subscriber carrier systems and equipment will be distributed by Automatic Electric Sales (Canada) Ltd. A complete supply, repair and replacement service for the entire range of systems and equipment has also been established by Lenkurt Electric at Vancouver.

The systems provide a method of obtaining up to 10 additional subscriber circuits from an existing wire line, or up to 20 such circuits from the same pole-lead.

UK group here to boost instrument sales

The first group of U. K. manufacturers to follow up the visit of the Canadian trade mission to Britain last December, visited Toronto, Hamilton, Ottawa and Montreal last month. A team of scientific instrument manufacturers, they had a full program of discussions with groups representing leading Canadian institutions and industries.

Help in arranging the program came from the Board of Trade, the Federation of British Industries and the Dollar Exports Council in London; the Dollar Sterling Trade Council, the Canadian Association of British Manufacturers and Agencies and the U. K. Trade Commissioner's Service in Canada.

L. A. Woodhead, leader of the team, is a director of Cossor Instruments, hon. secretary of the Scientific Instrument Manufacturers' Association of Great Britain and chairman of its Electronics Section. He said that since Canada imports about 90% of her scientific instrument needs and about 95% of these imports are from the U. S. A., a significant increase in imports from the U. K. would not be prejudicial to Canadian instrument manufacturers' sales. He suggested that it would not only help the research and development of Canada's primary and secondary industries, but would also assist in increasing U. K. dollar reserves, making the purchase of more Canadian products possible.

Mr. Woodhead also stated that the members of SIMA planned to set up group selling organizations in Canada, to be based on existing nuclei.

News in brief

Canadian Applied Research Ltd., Toronto, are now exclusive Canadian distributors for Kearfott Co., Inc., Little Falls, N.J. (synchros, servo motors and gyros).

E. S. Gould Sales Co., Montreal, represent San Fernando Electric Mfg., Co., San Fernando, Calif., in Quebec and Ottawa (capacitors, filters and potentiometers).

Radionics Ltd., Montreal, are Eastern Canadian representatives for Baird Atomic, Inc., Cambridge, Mass. (atomic instruments and systems).

A. C. Wickman Ltd., Toronto, are marketing in Canada the products of Dynamic Instrument Co., Cambridge, Mass. (strain gauge pressure transducers, flow meters and force transducers). Wickman have also been appointed representatives of Daytronic Corp., Dayton, Ohio (motion transducers, force transducers, controllers, transducer amplifiers).

New Canadian representatives of Radiation Counter Laboratories, Inc., Skokie, Ill., are Electromechanical Products of Agincourt, Ont.

Mark Simpson Mfg. Co. Inc., Long Island City, N.Y., manufacturers of "Masco" intercommunication equipment, public address amplifiers, high fidelity and tape recorders, have appointed two Canadian factory representatives. Western Canada: E. C. Short, president of Emerson Record Sales, Inc., Vancouver 4, B.C. Eastern Canada: William M. Hummel, Port Credit, Ont.

Delta Aircraft Equipment Co., Toronto, will handle Canadian sales for Revere Corp. of America, Wallingford, Conn. (high temperature hook-up and thermocouple wire and cable, electrical and thermocouple harnesses, etc.).

SIMA group visits Canada. Standing, left to right: Dr. V. A. Sheridan, director, British Physical Laboratories; John L. Bonus, general manager, The Canadian Association of British Manufacturers and Agencies; D. Pitman, sales director, Electronic Instruments Ltd.; W. H. Storey, managing director, Unicam Instruments. Sitting: J. R. W. Wilby, U. K. Trade Commissioner for Ontario; L. A. Woodhead, director, Cossor Instruments (leader of the team); D. R. Stanley, director, Hilger & Watts. Secretary of the team (not in picture) was S. A. Rybb, general manager, Canadian operations, Dawe Instruments Ltd., Ottawa.

The facts are perfectly clear

When you choose PHILCO *Industrial Television*

Philco Industrial Television has literally dozens of applications: schedules the flow of materials to the production line: time and motion studies; better warehouse control.

Philco ITV means you can watch for spillage and pile-ups on long conveyer lines; reading meters and gauges in remote spots; watch unloading operations.

Philco, a pioneer of industrial television, is providing industry with an invaluable tool for checking literally dozens of processing and manufacturing operations.
Philco Industrial TV cameras are gradually taking over jobs that humans could never check because of weight, size, climatic or hazardous conditions.
Philco Sales and Service Representatives are being set up all over Canada to assure you of full time operation of your equipment.

WRITE TO DEPARTMENT 'M'

PHILCO GOVERNMENT AND INDUSTRIAL DEPT.

DON MILLS, ONTARIO

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Special Features

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PRICE, without plug-in units, **$1050**

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FIRST IN CANADA...

C-G-E now manufactures germanium rectifiers–

reducing price and increasing availability

A new Canadian industry is born! A new industry developed to serve the special needs of the electronic equipment manufacturer. Now, from Canadian General Electric . . . semi-conductor products . . . give you three major benefits!

- An appreciable reduction in price due to lowered costs. It is anticipated that price will continue to drop as production facilities expand.
- Greater availability due to a greatly improved stock control. It will be possible to adjust the manufacturing pace to comply with the Canadian market demand.
- Better service because of improved application-engineering knowledge. C.G.E. Engineers will be able to apply the first-hand knowledge – gained in overcoming manufacturing problems – to improve many types of electrical and electronic mechanisms. It is expected that this will lead to a more extensive use of efficient, compact semi-conductors in all Canadian industry.

The popular IN91-2-3 Series G-E Axial Lead, Low-Current Germanium Rectifiers will be the first to go into Canadian production. Later in the year production of G-E Silicon Rectifiers will be added.

For detailed information on the availability and new low prices of the IN91-2-3 Series G-E Rectifiers and for data on all G-E Semi-Conductors contact your nearest C.G.E. Sales Office or write to Electronic Tube Department, Canadian General Electric Co. Ltd., Dufferin Street, Toronto, Ontario.

GENERAL ELECTRIC
SEMI-CONDUCTOR
RECTIFIERS

ELECTRONIC EQUIPMENT AND TUBE DEPARTMENT

1399-158

CANADIAN GENERAL ELECTRIC COMPANY LIMITED

Circle No. 19 on Reader Service Card

Circle No. 14 on Reader Service Card

Emergency Power—IN HALF A SECOND

with Lenkurt emergency a-c power supply panels

Lenkurt Type 5060A and Type 5070A emergency a-c power supply panels furnish up to 250 watts of a-c power from storage batteries. Operation is automatic upon failure of the normal a-c power.

These emergency power supplies are particularly suitable for communications applications. They are designed to meet a wide range of applications where a-c operated equipment at attended or unattended locations cannot be interrupted for even short intervals. The rated load capacity is ample to assure uninterrupted operation of a complete carrier terminal (such as a Lenkurt Type 33A three-channel assembly), a carrier repeater, a small radio station, or similar equipment.

Either existing telephone battery plant or automobile type storage batteries can furnish the necessary power source for emergency operation. An automatic battery charger can be used in conjunction with the batteries at unattended installations.

Design Features

- **Fast**—Full load is taken within 0.5 seconds after transfer is initiated.
- **Automatic**—Normal a-c power source is monitored so transfer is initiated automatically whenever the normal source drops below about 60 volts.
- **Convenient**—Arranged for mounting on standard 19″ relay rack, the panel also can be adapted for wall mounting if desired.
- **Minimum Maintenance**—Simple design uses only three relays and a dependable rotary converter.
- **24 or 48 Volt Battery**—Type 5060A operates from 48-volt telephone battery.

  Type 5070A operates from 24-volt telephone or automobile type storage batteries.
- **Easily Installed**—Normal a-c power, load, battery, and alarm are only connections required.
- **Load Adjustment**—Dropping resistors can be strapped to accommodate loads less than 250 watts.

For complete information write or call your nearest Automatic Electric office.

Automatic Electric Sales (Canada) Limited, 185 Bartley Drive, Toronto 16, Ont. Branches in Montreal, Ottawa, Brockville, Hamilton, Winnipeg, Regina, Edmonton, Vancouver.

L-5507-R

AUTOMATIC ELECTRIC

ORIGINATORS OF THE DIAL TELEPHONE

GENERAL SYSTEM

Circle No. 13 on Reader Service Card

After the conference—what next?

At the time of writing our editorial comment for last month's issue, the Canadian Conference on Education had just completed its five-day meeting in Ottawa. A copy of the resolutions passed at the plenary session on February 20 has since been made available.

We believe that some of the results of the deliberations of this "people's parliament for education," as it was picturesquely called by Chairman Dr. Wilder Penfield, are of vital importance to the future of the Canadian electronics industry. For example:

Student Aid: Be it resolved that this conference urge upon the provincial and federal governments, and industrial, business and other institutions, the provision of funds for an adequate student-aid program.

National Research Advisory Committee: Be it resolved that this Conference recommend to the Privy Council of Canada that it appoint a national committee to include, among others, representatives of the physical, engineering, and life sciences who are familiar with the basic research requirements of Canadian universities, to examine the following:

(a) the development of a national policy for the promotion of basic research,
(b) the means by which this research, particularly in the universities, can be more adequately supported.

Technological Education: Be it resolved that Departments of Education be urged to expand facilities for technological education.

University Institutes of Research: Be it resolved that Canadian universities consider the feasibility of forming "Institutes of Research" in the universities to be supported wholly or in part by federal government grants.

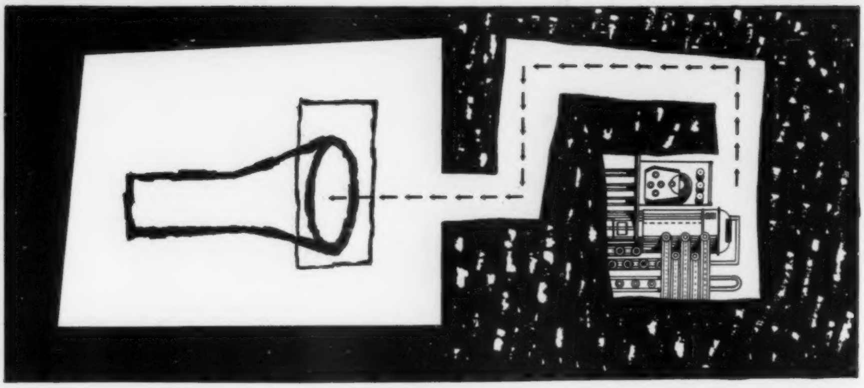
Basis for Federal Grants to Universities: Be it resolved that representations be made to the appropriate authority to the end that annual federal grants to universities and colleges be made on a more realistic and equitable basis to take into account the increasing proportion of student enrolment to the total population and the rising cost per student.

Federal Grants for Technical Institutes: Be it resolved that the federal government be petitioned to provide special grants, for both capital and operation expenditures, for the further development of Institutes of Technology at the post-secondary school level.

Teachers' Salaries: Be it resolved that salary levels be established that will enable teachers to secure financial rewards equal to those paid to people with similar qualifications in other professions.

We can find no better summary of this group of resolutions than the remark of Dr. A. W. Trueman of the Canada Council: "There is nothing wrong with Canadian education that a great deal of money, properly applied, would not set right."

THE EDITOR



HAROLD PRICE
EDITOR

Closed circuit television: small market

Canadian sales of closed circuit television equipment have not been large to date, but long-term prospects are very encouraging. Definitely a buyers' market and one in which the suppliers have a big job of customer education to do

Closed circuit, or industrial television has hardly begun to be a significant factor in the total Canadian market for the products of the electronics industry, but increasingly rapid growth is foreseen. General opinion is that Canadian sales are lagging those in the United States by at least two years, and estimates of the proportionate sales potential in the two countries vary from one tenth to one twentieth.

Total sales in the U. S. have been estimated at $3 million in 1956 and $5-10 million in 1957, with a forecast of at least a $75-100 million market in the next 10-15 years. Current level is about $10 million per annum, which gives an extrapolation of about $500,000 for the Canadian market potential in 1958.

Equipment prices for a single camera-control unit-monitor link vary over a wide range. Some suppliers have two lines, one comprising the simplest equipment possible, with vidicon or staticon pick-up tubes, and the other using image orthicon tubes and giving reliability and picture quality of broadcast standard. Cost of a link may therefore vary from as low as $1,500 - $2,000 to the $10,000 - $20,000 range.

The market to date has not justified any Canadian companies manufacturing a complete line of equipment in their own plants, but at least one has made some accessories and another is planning production of cameras, monitors and controls in the foreseeable future.

The companies who are now selling equipment in Canada include:

Caldwell A-V Equipment Company Ltd.,
Toronto. (Dage equipment)

Canadian General Electric Company Ltd.,
Toronto. (General Electric)

Canadian Westinghouse Company Ltd.,
Hamilton. (General Precision Laboratory)

Electronic Associates Ltd.,
Willowdale, Ontario. (Own manufacture)

General Theatre Supply Company Ltd.,
Toronto (Hallamore)

Philco Corporation of Canada Ltd.,
Don Mills, Ontario. (Philco)

Philips Electronics Industries Ltd.,
Toronto. (Philips, Eindhoven)

Pye Canada Ltd.,
Toronto. (Pye, Cambridge)

RCA Victor Company Ltd.,
Montreal. (RCA)

Telequipment Manufacturing Company Ltd.,
London, Ontario. (Blonder-Tongue)

Thompson Products Ltd.,
Toronto. (Dage)

In addition, TelePrompTer of Canada Ltd., Toronto, are active in the field of closed circuit large-screen presentations, using Pye and Dage cameras, Fleetwood and GPL projection equipment.

As can be seen from the examples illustrated on the following five pages of this article, applications cover almost every field imaginable. In industry it is often possible to reduce manpower and/or make processes more efficient. Many examples are also available of the use of television links for the surveillance of personnel, plant boundaries or inaccessible equipment. Another area which is currently receiving a great deal of attention in the U. S. is that of watching and controlling the millions of vehicles using expressways and freeways daily. One forecast puts the potential for this application alone as "a $10 million market within two years after the first permanent installation."

Typical applications

1 *Railway traffic control at complex junctions and marshalling yards. Application to freight-car number logging is being studied.*

2 *World's first three-dimensional color system for remote servicing of reactors at AEC Idaho Falls test site. Operator keeps model trucks aligned in this unclassified demonstration.*

3 *Lesson on gross anatomy of frog is seen by second grade ten class in this Scarborough, Ontario high school demonstration.*

4 *Large-screen presentation. This audience in Toronto joined others in Ottawa, Montreal and 60 U. S. cities in a two-day sales training program.*

with a big future

Equipment has already been sold in Canada for a wide variety of applications. Suppliers have, however, encountered a degree of sales resistance on the part of some Canadian subsidiaries of American companies. They have occasionally been reluctant to consider applications on which their parent organizations had not already had experience. This has, of course, contributed to the lag in Canadian sales referred to above.

Some typical installations include:

Avro Aircraft Ltd., Malton, Ontario — flight simulation applications.

Dominion Foundries & Steel Company, Hamilton — monitoring of visual instructions between stages on rolling mill, necessary because of high noise level.

Orenda Engines Ltd., Malton, and National Research Council Laboratories, Ottawa — surveillance of jet engines in test cells.

Atomic Energy of Canada Ltd., Chalk River, Ontario — classified.

Peterborough Post Office — surveillance of personnel.

Provincial Raceways, Richlieu track, Montreal—monitors in control centre display tote board.

HMCS Bonaventure — display of tactical information in pilot briefing room.

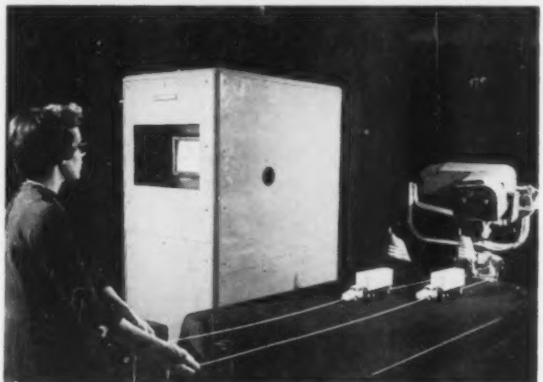
Steel Company of Canada Ltd., Hamilton — general manufacturing supervision and process control.

The Alberta Government have purchased equipment for use in schools. Educational uses of closed circuit television possibly represent the most promising market in Canada for the next few years. This was underlined by a very favourable resolution passed by the recent Canadian Conference on Education. The experience of U. S. educators in several experiments has, however, shown that much study of the problems involved is essential before making permanent installations.

Conclusion: a small market at present, but one with a very bright future. END

See next four pages for more applications . . .

1 PHILIPS ELECTRONICS INDUSTRIES LTD.

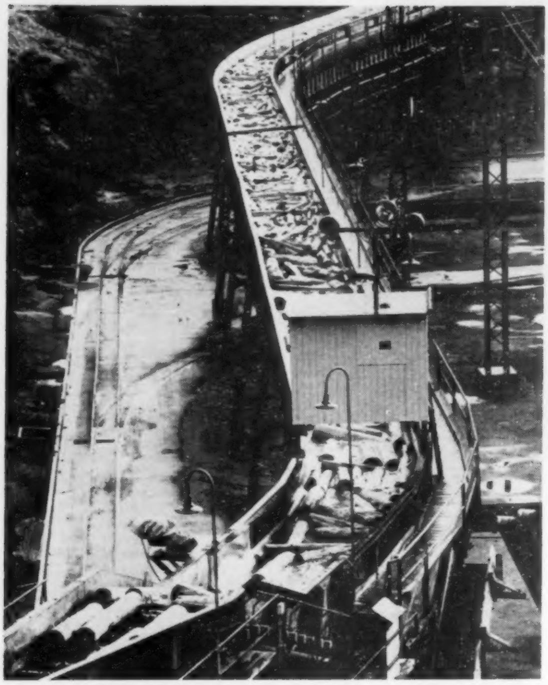


2 CANADIAN GENERAL ELECTRIC COMPANY LTD.

3 CANADIAN WESTINGHOUSE COMPANY LTD.

4 TELEPROMPTER OF CANADA LTD.

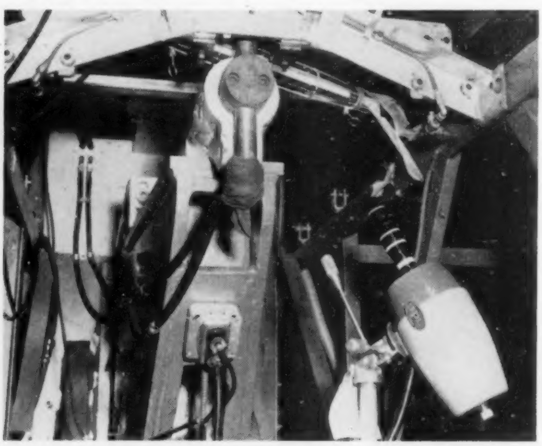
Preventing log jams



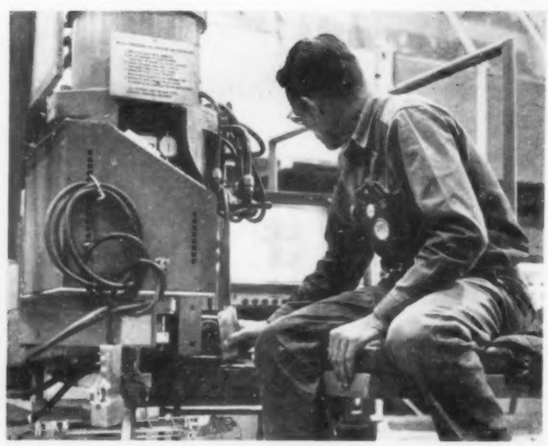
Seventy-five miles north of Vancouver, at the Powell River Co. Ltd. newsprint plant, industrial television is helping to co-ordinate the flow of pulpwood logs from the barkers to the grinders—giving one man complete surveillance and control of a troublesome transfer point. Pye Canada Ltd. camera is installed in shelter shown at left; conveyor operator sees blocks transferring from water flume to mechanical conveyor on monitor screen at right.

CCTV
controls material, saves manpower, aids doctors

Spotweld quality control

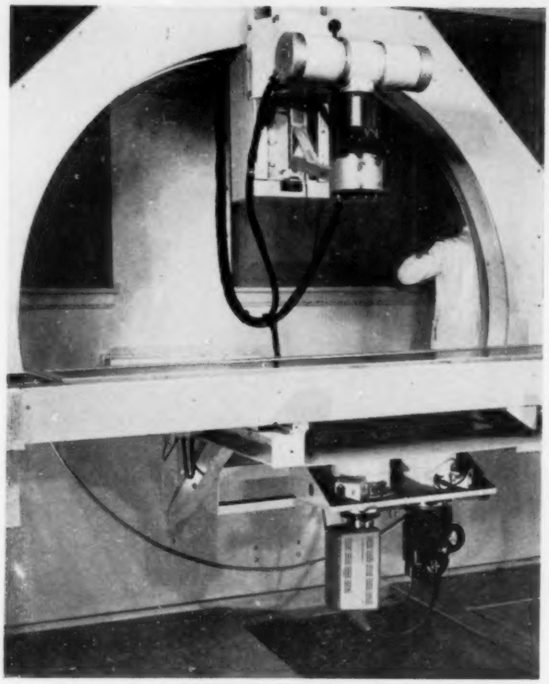


General Precision Laboratories camera at Ryan aeronautical plant eliminates need for a "bird-watcher" formerly stationed beneath welding platform who kept eyes trained on spotwelds to detect build-up of "clad."



Spotwelding machine operator can easily keep track of quality of welds on underside of aluminum panel by checking enlarged 5½ inch diameter spots on monitor at rear. Thus one man is released for more productive work.

X-ray fluoroscopy



Philips Electronics Industries Ltd. recently completed this installation at Montreal's Jean Talon Hospital. Motion picture and TV cameras pick up X-ray image of patient on table. Each is fitted with an image intensifier.

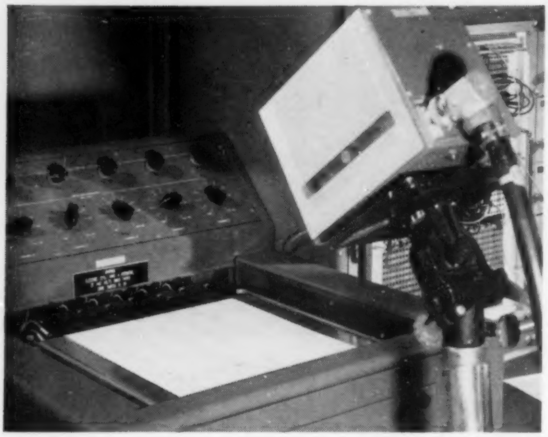
Dr. Guy Duckett, chief radiologist at Jean Talon, watches monitors in daylight in adjoining radiation-free room. Controls for the moving examination table are mounted on the small panel at lower right of picture.

Chip-bin level control

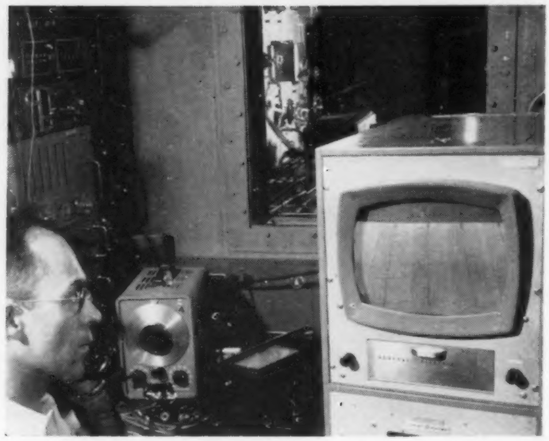
Canadian Westinghouse Co. Ltd. installation at Dryden Paper Company plant, near Dryden, Ontario. GPL cameras are located at the top of a chip storage bin and at the chip removal system at the bottom of the bin.

Operator checks contents of bin and movement of chips to digestor operation. Bin has sufficient capacity to carry digestors for several hours and allows chip supply equipment to be shut down for maintenance without production loss.

Jet engine development



General Electric camera picks up test data as it emanates from analogue computer and is displayed on a six-channel recorder. Data is transmitted to test site some 200 feet distant. Releases technician who used to telephone data and reduces test time as much as 50 per cent.

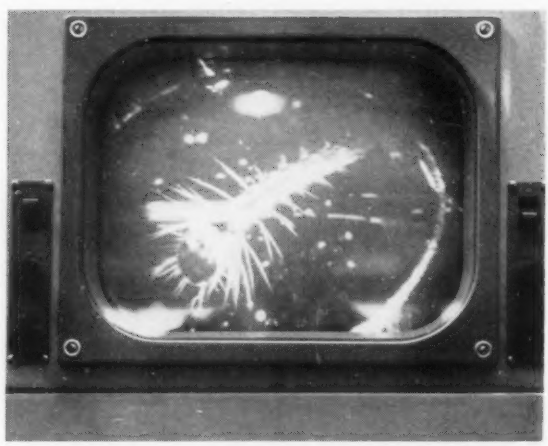


Test engineer views monitor and checks computer data with operating characteristics of component under test in cell at rear. If operations of component under test are not in complete synchronization with data received, engineer can immediately make the necessary adjustments.

CCTV

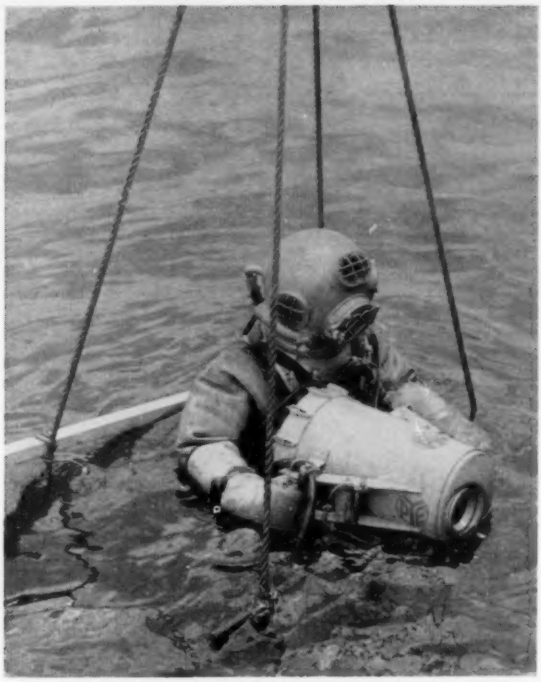
valuable tool for engineer, researcher, teacher

Microscope viewing



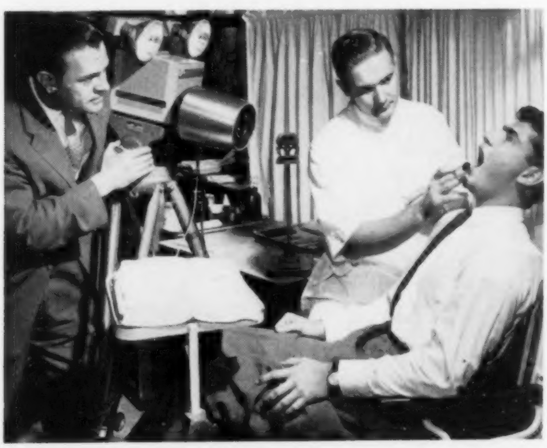
As an aid to easier viewing with a microscope, closed circuit television can really score—for either research work or classroom demonstrations. These photographs from Philips Electronics Industries Ltd., show how conveniently the camera can be mounted above the microscope and the picture quality that can be obtained. Object of this particular exercise was a mosquito larva.

Underwater inspection



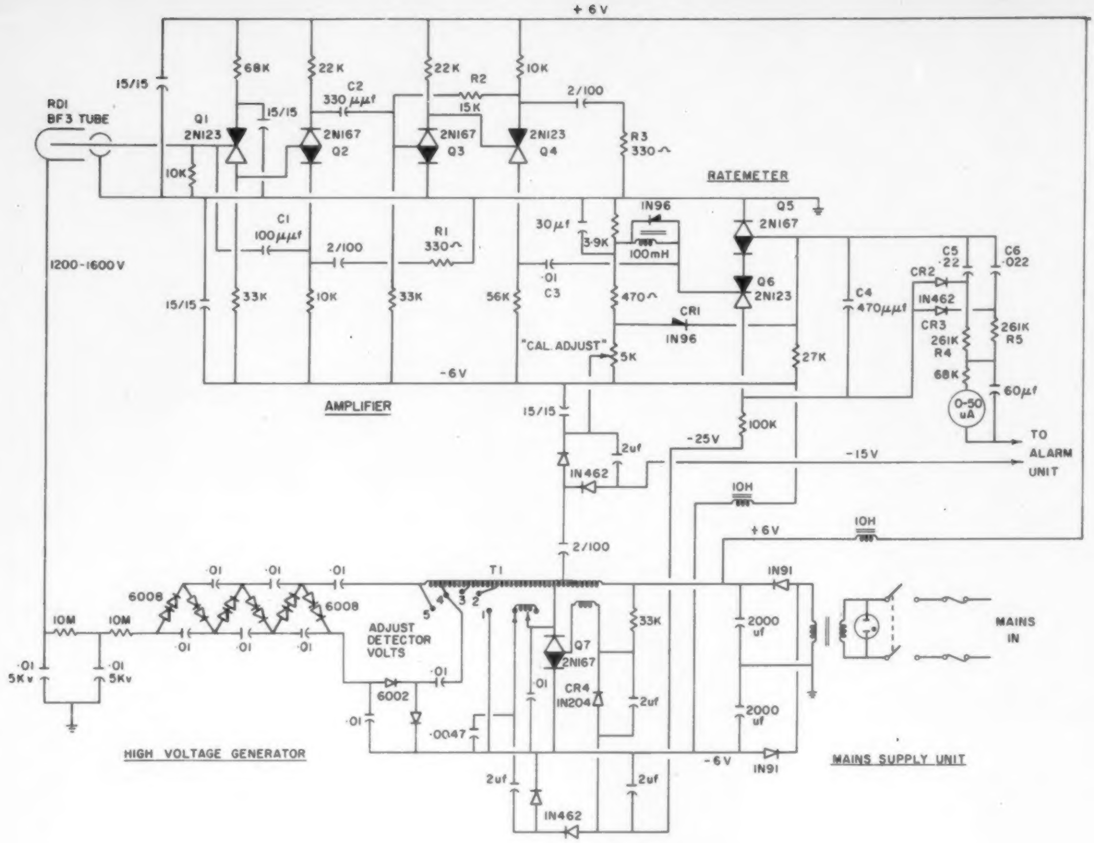
One of many possible underwater applications. Picture at left shows diver with Pye camera developed for underwater use about to submerge off the jetty of the British American Oil Company's refinery at Clarkson, Ontario. Diver stayed under for six to seven hours, aiming camera at jetty structure. Civil engineers on dry land checked the condition of the concrete and decided what repairs were necessary.

Practical dental training



Canadian General Electric arranged this demonstration at the University of Toronto Dental College late last year. Demonstrator's techniques can be clearly shown to a large group of students and he can answer any questions via a public address system.

Sophomore student at New York University College of Dentistry directs questions to studio demonstrators in another General Electric application. The televised demonstrations are "piped" into several lecture halls at the college from a central studio.



Transistorized slow neutron monitor uses proportional counter

V. H. ALLEN*

The instrument described here has been designed for use as a health monitor to be used in fixed positions in a building housing a nuclear reactor. In the past most monitor instruments have used an ion chamber detector followed by a dc amplifier. The present instrument uses a proportional counter as the detector and the pulses produced are amplified before being used to drive a ratemeter. The pulse rate type of measurement represents a different approach to the problem and should give greater stability than methods employing ion chambers and dc amplifiers. The monitor measures the slow neutron flux at its location and is usable over the range of fluxes of 200-20,000 neutrons/cm²/second. Transistors are used throughout

*Atomic Energy of Canada Ltd., Chalk River, Ontario.

Slow neutron monitor AEP No. 2136 is a fully transistorized instrument designed for use over the range of 200-20,000 neutrons/cm²/second. The use of transistors throughout should result in a high degree of reliability and it also enables a compact instrument to be made.

The instrument can be divided into three separate sections, each of which will be described in turn.

Detector and amplifier.

The slow neutron detector is a proportional counter filled with boron-trifluoride (BF_3) gas. A neutron reacting with a B^{10} nucleus produces an alpha particle which ionizes the gas in the tube. The charge produced by the alpha particle is amplified by gas amplification in the counter resulting in a charge collection of about 10^{-14} coulombs at the anodes of the tube. This charge must be amplified to drive the trigger circuit and the pulses which this circuit produces are used to indicate the pulse rate.

The amplifier consists of two stages each containing a p-n-p and an n-p-n transistor. Consider the first stage. The collector of Q1 is directly coupled to the base of Q2 and with the values of resistors shown the voltage gain from

the base of Q1 to the emitter of Q2 is about 1,000. Negative feedback is applied between the emitter of Q2 and the base of Q1 by means of the capacitor C1. It can be shown [1] that the input point of a fedback amplifier having high internal voltage gain may be regarded as a virtual ground and that nearly all the input current will flow through the feedback elements. In the present case, to a close approximation, current due to charge collection at the anode of the BF_3 tube will flow into capacitor C1, and C1 will therefore acquire a charge equal to that which is collected by the tube. Since the base of Q1 is a virtual ground the plate of C1 which is connected to the emitter of Q2 will change in voltage during the detector tube charge collection time. For the duration of the pulse, the emitter load of Q2 is R1 and this resistor will define the pulse current in Q2. The first stage of the amplifier thus integrates the input charge and presents a capacitive load to the detector tube. The output current pulse at the collector of Q2 decays slowly following its initial rise, the decay time depending on the circuit constants in the input stage of the amplifier.

The second stage of the amplifier (Q3 and Q4) is coupled to the first by means of capacitor C2. Nearly all the pulse current in Q2 will be transmitted to the second stage by C2 and some differentiation of the pulse will be produced by this coupling. Differentiation at this point is desirable since it reduces noise produced in the input stage of the amplifier. It is also necessary in order to prevent pulse build up and blocking in later stages of the circuit. Q3 and Q4 are directly coupled and feedback is applied between the emitter of Q4 and the base of Q3 by means of resistor R2. The base of Q3 may be regarded as a virtual ground and therefore nearly all the pulse current supplied by the first stage will flow in R2. Resistor R3 which is coupled to the emitter of Q4 will define the change of current in Q4 and thus the current gain of the stage will approximate to the ratio of R2 and R3. The pulse current in Q4 is coupled into the ratemeter trigger circuit by capacitor C3.

A brief analysis of the amplifier is contained in the appendix.

Ratemeter [2]

The trigger circuit makes use of the complementary properties of p-n-p and n-p-n transistors. An n-p-n transistor Q5 and a p-n-p transistor Q6 are arranged in series as shown in the schematic. In the resting condition the transistors are held in the non-conducting state since the base of Q5 is held at a lower potential than the base of Q6 by the diode CR1 connecting it to the resistor chain between ground and —6v. When a negative pulse occurs at the collector of Q4 it is transmitted to the base of Q6 and this turns on current in Q6. The positive pulse which is developed at the collector of Q6 is coupled to the base of Q5 by capacitor C4 and the clamping diode CR1 is thereby cut off. At the same time the emitter of Q5 is being reduced in voltage by reason of the negative pulse on Q6 base and, hence, a very fast increase of current occurs in the transistor chain resulting in trigger action. The increased current will be maintained until the charge on C4, and any other capacitors connected between Q5 base and Q6 collector, has leaked away, when the circuit will restore to its original nonconducting condition.

Each time the circuit triggers, a positive pulse occurs at the collector of Q6 and this is coupled to the ratemeter circuit by two diodes CR2 and CR3. When the circuit triggers the two capacitors in the ratemeter, C5 and C6, are effectively short circuited, but when the circuit restores to its original condition these capacitors will recharge. The charging rates will depend on the time constants C5R4 and C6R5 and also on the voltage across the combination. The meter measures the average recharging current and since this current depends on pulse rate the meter may be calibrated in pulse rate. The range of the meter scale can be adjusted by varying the time constants referred to above. For random input pulses the scale of the instrument is approximately logarithmic over two decades of counting rate, from 200 to 20,000 counts per minute. A setting up adjustment of meter scale may be made by means of the "CAL. ADJUST" potentiometer which varies the nominal —15v line.

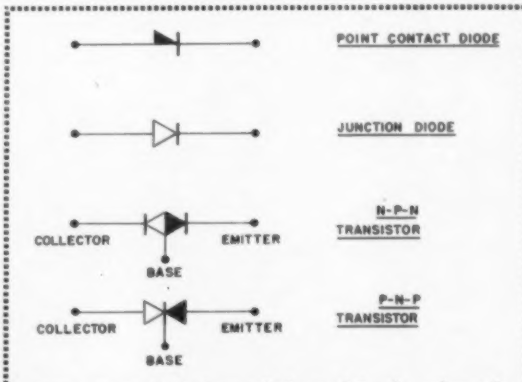
High-voltage supply

The proportional counter tube requires a voltage in the range 1,200 to 1,600 volts and this is provided by an hf. type power supply. Transistor Q7 is connected by an oscillator which operates at about 8 kc. A waveform of 20 volts peak to peak is generated at the collector of Q7 and this is transformed to 400 volts p. to p. at the output of the auto-transformer. The transformer output voltage is rectified and multiplied by a three-stage Cockcroft-Walton multiplier producing a direct voltage of 1,200v. Additional voltage is obtained by including in the bottom of the multiplier a single section of multiplication fed from a variable tap on the transformer. The tap used may be selected by means of a switch so that the final output can be changed in 100 volt steps. The provision of four high-voltage settings makes it a simple matter to determine the voltage plateau of the counter-amplifier system.

Direct voltages of —25 and —15 volts are also generated by using other taps on the transformer and these voltages are used in the ratemeter.

Stabilization of the output voltage is obtained using a "Zener" diode, CR4, as a reference voltage source. A change in the amplitude of the alternating voltage at the collector of Q7 will result in a change in the level of the —25v line. The bias on the base of Q7 will therefore be adjusted to maintain the output voltage nearly constant. This method of regulation will not compensate for changes of output voltage due to part of the effective impedance of the transformer and multiplying circuit. Since the load on the supply is very small, compensation against variations in the +6v lines and —6v lines is more important.

The output from the high-voltage supply has been arranged to be negative with respect to ground. This means that the case of the counter tube is at a high negative potential and the tube requires special mounting arrangements. The disadvantage of this is offset by the fact that the anode of the tube may be kept at ground potential. A high-voltage coupling capacitor to the amplifier is thereby eliminated and this avoids problems which would arise due to small breakdown pulses in such a capacitor.



Transistor and diode symbols used in the schematic

Acknowledgments

The basic circuits used in the instrument described were originated by F. S. Goulding whose advice and assistance are gratefully acknowledged. W. C. MacGregor did much of the prototype construction and testing.

APPENDIX

Pulse amplifier gain

Consider the input stage consisting of Q1 and Q2. The internal voltage gain of the stage is high and therefore the base of Q1 may be regarded as a virtual ground. Nearly all the input pulse current will flow in the feedback element C1. Hence this capacitor will acquire the same charge as that deposited on the anode of the detector tube by an ionizing event.

If this charge is q coulombs then the change in voltage at the emitter of Q2 will be

$$\frac{q}{100 \times 10^{-12}} \text{ volts}$$

The emitter current will be

$$\frac{q}{33 \times 10^{-9}} \text{ amps.}$$

It will be sufficiently accurate to take the alpha of Q2 as unity. Therefore the current found above may be regarded as flowing in the collector of Q2 and hence into the second stage.

The base of Q3 is a virtual ground so that the emitter of Q4 will change in voltage by

$$\frac{q \times 15 \times 10^{3}}{33 \times 10^{-9}} \text{ volts.}$$

Emitter current change will be

$$\frac{q \times 15 \times 10^{3}}{33 \times 33 \times 10^{-8}} \text{ amps.}$$

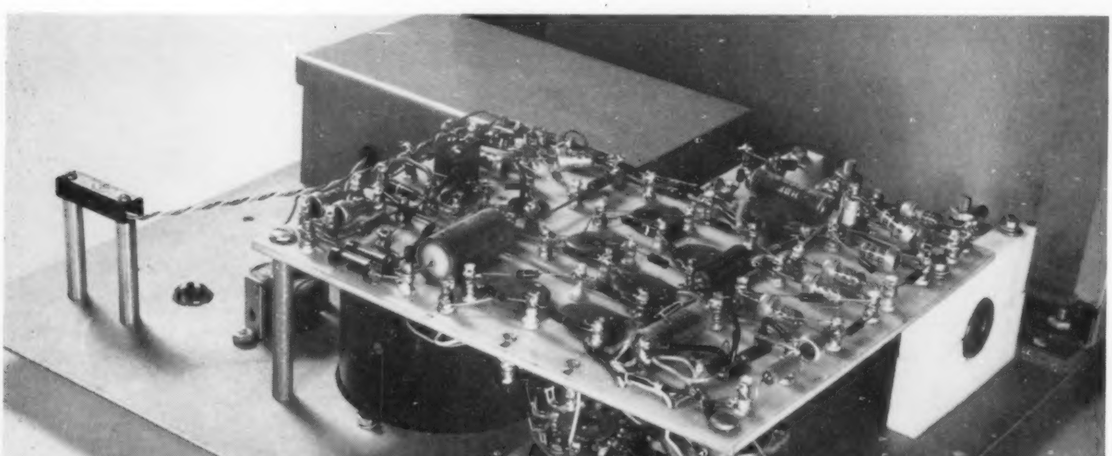
if transistor alpha is again taken as unity. This current is available for driving the ratemeter. With the tube used in this instrument q will be of the order of 10^{-14} coulombs. The amplifier will then provide a current of approximately 14×10^{-6} amps for driving the ratemeter. END

Slow neutron monitor is self-contained in metal cabinet. Rate meter has log scale for counts up to 20,000 per min.

REFERENCES:

1. *Automatic Strobes and Recurrence—Frequency Selectors by F. C. Williams, F. J. V. Ritson and T. Kilburn. Journal of the Institution of Electrical Engineers, Part III A, 1946, 1275.*

2. *Transistor Circuit Design for a Radioactivity Contamination Meter by F. S. Goulding. Atomic Energy of Canada Ltd., publication CREL-605.*



The neutron detector is a proportional counter filled with boron-trifluoride gas. Transistors are used throughout

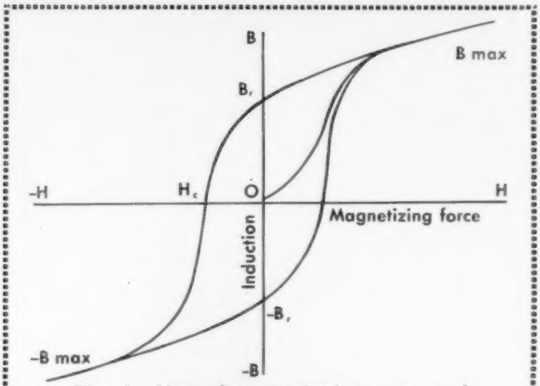


Fig. 1. Normal magnetization curve and hysteresis loop

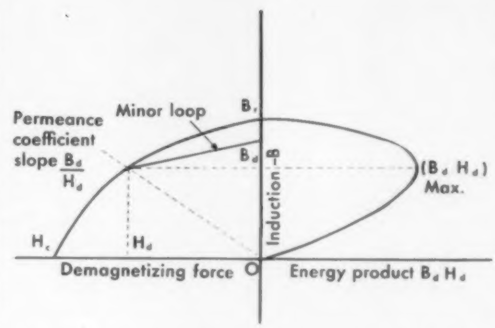


Fig. 2. Demagnetization and energy product curve

Fundamentals of magnetism

a guide for product designers

CHARLES A. MAYNARD*

There are three fundamentals of magnetism which apply to all permanent magnet applications—a permanent magnet is a hysteresis element—its energy is potential—there is no insulation for magnetism. The author discusses these fundamentals and describes ways in which engineers can utilize them in product design

A magnet is a hysteresis element. When it is placed in a magnetizing field, the magnet becomes magnetized, and upon removal from the magnetic field a large portion of the magnetization is retained. This retention of magnetism is due to hysteresis; namely, the tendency for a body or matter to remain in the previous state or condition upon a reversal of an applied force. In a permanent magnet this applies not only for initial magnetization but also for any other reversal of applied magnetizing, or demagnetizing, conditions.

This phenomenon is often encountered in using magnets. If, for example, a loudspeaker magnet is magnetized in the magnetic assembly, the field produced in the air gap in a typical speaker would be 10,000 gauss. However, if the magnet is removed from the assembly and then replaced, the field produced by the magnet in the gap would only be about 3,000 gauss.

What has happened? When the magnet is removed from the speaker it is subjected to a greater demagnetizing condition than was present when the magnet was magnetized in the speaker. Owing to this additional demagnetizing force, the flux density in the magnet was substantially reduced and although it was placed back in its original magnetic circuit, the interim condition reduced the flux density produced in the air gap.

One of the most important factors in the design of permanent magnets is the recognition of this phenomenon. Often by proper design and magnetizing procedures this intermediate demagnetizing condition can be eliminated and a much smaller magnet can be utilized to produce the desired results.

This factor of hysteresis is also apparent when comparing various permanent magnet materials. Generally, the hysteresis is graphically indicated by a curve (see Fig. 1) and the area enclosed in the curve is a measure of the quality of the permanent magnet material. Most of the required information as to permanent magnet characteristics is contained in the second quadrant of the hysteresis loop known as the demagnetization curve (see Fig 2). It also indicates in practically all applications the condition under which the magnet is working.

There is one point on this curve, known as peak energy product, at which a permanent magnet material is utilized most efficiently. This value is most often given for determining comparative quality of permanent magnet materials. The characteristics indicated by the hysteresis loop, the demagnetization curve and associated minor hysteresis loops are basic information required by engineers for efficient design. This information is also of value to the metallurgist, as it is the basis upon which improvements in permanent magnet materials are determined.

Many advances have been made in the past 30 years in improving the energy that is available from a permanent magnet. Prior to 1918, there were only tungsten and chrome permanent magnet materials which produced a maximum energy product of only 0.3×10^6 BH. At present there are various grades of Alnico, Alnico V having the highest energy product (more than 0.525×10^6 BH). A recent grain-oriented Alnico V, called Hyflux Alnico V HE and manufactured by The Indiana Steel Products Com-

*The Indiana Steel Products Co., Valparaiso, Ind.

pany, produces an energy product of 0.6 x 10^6 BH, but is limited to comparatively short, straight lengths.

The quality of permanent magnet materials has been improved to such an extent that it only requires approximately 1/17 as much material as it did at the end of World War I. In addition to the Alnicos, ductile, ceramic and other permanent magnet materials having special characteristics have been developed.

Potential energy:

The energy of a permanent magnet is potential energy and not kinetic energy. By definition, potential energy is energy which depends upon its condition or position. A weight placed upon a table has potential energy with respect to the floor. Likewise, a U-shaped magnet which is magnetized has been placed in a definite condition known as an open-circuit condition. The condition can be represented by point (a) in Fig. 3, which indicates 0.5 x 10^6 energy product.

If the poles of the magnet are placed close to a steel bar, the steel bar is attracted to the magnet. Without going into details as to the internal changes within the magnet, it can be stated simply that the magnet is then in a different condition. This condition is indicated in Fig. 3 by point (b) which shows zero energy. Line ab indicates the change in energy produced by the magnet in going from the open-circuit condition (a) to the closed-circuit condition (b). However, if the steel bar is removed, the magnet returns to the original condition and energy as indicated by point (a).

It is interesting to note that if the energy produced by the magnet upon attracting the bar is measured and compared to the energy required to remove the bar from the magnet, they will be found to be equal and opposite. The permanent magnet in itself has not produced or used up any kinetic energy.

This explains why they may be termed permanent magnets. The magnet is not dissipating energy. Consequently, it will remain permanent. The magnet acts as a transducer, being an agent for changing one form of energy to another without losing any of its energy.

Magnetic insulation?

There is no insulation for magnetism and the realization of this factor is very important. It is because of this characteristics that permanent magnets can be used at all. In practically all permanent magnet applications, it is necessary that a magnet produce a magnetic flux in an air gap. In this air gap may be moving coils, another magnet, or magnetic material, or perhaps even moving electrons. Utilization is based upon the consideration that in this air gap certain definite interactions are obtained. In some cases not only is the air gap present, but also the magnetic field is required to pass through glass, brass, or other nonmagnetic materials. Careful studies have been made, and with the exception of very minute variations, the magnetic field is the same regardless of the presence of such nonmagnetic materials.

Since there is no insulation, a field cannot be obtained in a desired portion of the magnetic circuit without having stray fields in other portions. The total flux is divided into two portions: the useful flux and leakage flux. The ratio of the total flux produced by the magnet to the useful flux will vary greatly with different designs. In some designs the total flux may be only 1¼ times that of the useful flux, whereas in other designs the total flux may be 50 times, or even more, than that of the useful flux. This leakage flux accounts for some of the unusual shapes and changes in sections that are to be found in some magnets of efficient design.

There are also various physical characteristics that are associated with the various grades of permanent magnet materials which affect the design of the magnet. For example, the Alnicos are cast or sintered materials and cannot economically be machined or drilled, and any finishing is obtained by grinding. Others, such as the cobalt and chrome and tungsten grades of materials, can be drilled after annealing and prior to final hardening. Other materials, such as Cunife, may be machined in the final state, but can only be furnished with a small cross section. Indox is a ceramic material having very high resistivity.

Changing electrical to mechanical energy

The magnet in a motor acts as a transducer to transform electrical to mechanical energy and supplies the magnetic field which enables this transformation to take effect. One of the fundamental principles of electricity is that when a conductor carrying electricity is placed in a magnetic field, a force is produced which is at right angles to both the field and the conductor.

If a wire is placed in a magnetic field and current is passed through this wire, the wire will tend to be forced sideways in the magnetic field. This is a basic action in all electric motors. In dc motors a permanent magnet can be used to supply the field, and when current is passed through the armature, the motor will revolve. Many small motors are using permanent magnets in this way.

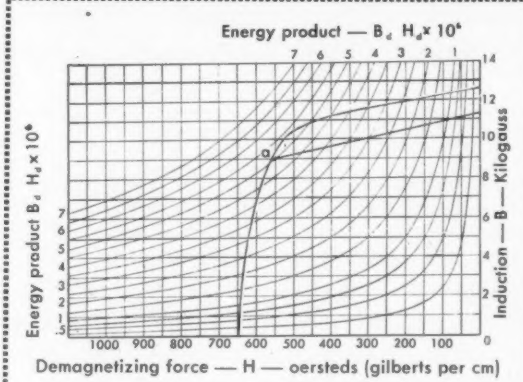


Fig. 3. Change in energy status

This principle is also used in the loudspeaker. The permanent magnet supplies the necessary field. The current passing through the voice coil which is attached to the diaphragm, produces a mechanical motion of the diaphragm, and sound is produced. It is also the basic principle in electrical instruments which measure voltage and amperage.

Many control devices utilize this fundamental instrument design. For example, pyrometers make use of a small thermocouple which is placed in the zone where temperature is to be measured. The voltage generated by the thermocouple is connected to the instrument which indicates the temperature directly.

The determination of the polarity of the charge of the mezon is a special application of this principle. As the mezon traverses the magnetic field, it is deflected, the direction of deflection depending upon the charge.

The magnetron tube used in radar depends upon the permanent magnet to produce a field which acts upon the electrons, causing them to take the desired path. Many motion picture projectors make use of an arc lamp as the light source. In order to hold this arc steady, the magnetic field of a permanent magnet is superimposed and causes the arc to take a desired path. New combinations are continually arising which make use of this principle.

Changing mechanical to electrical energy:

A transformation of mechanical to electrical energy is the reverse of the process described. It is the basic principle in the generation of power, namely, that when a conductor is moved to the magnetic field, an electrical potential is developed.

Generators may utilize permanent magnets to supply the field. In some of these generators the magnet is stationary and the moving armature carries the conductors. This arrangement is often used for dc generators and also inductor-type alternators. However, it may be more economical to rotate the magnet, especially for ac generators.

In aircraft, dependable ignition is supplied by the magneto. In some magnetos the magnet revolves, whereas in others the magnet and coils are both stationary, and an inductor rotor is used to shift the flux within a coil.

Magnetic phonograph pick-ups and dynamic and velocity type microphones use a permanent magnet to transform mechanical to electrical energy. A special case is the production of eddy currents in a copper or aluminum disc or sheet. As such a conducting sheet is moved in a magnetic field, eddy currents are produced. These currents are dissipated in the form of heat, but the reaction causes a mechanical movement or produces a force. One of the most familiar forms of this is the speedometer or tachometer. It is also used for the magnetic damping of laboratory balances.

Tractive forces:

The magnet is also used for its tractive effects. This is one of the most obvious uses, namely, the ability to attract a piece of steel or iron or another magnet. A repelling force can be obtained when two magnets with like poles are placed together.

One of the most common usages of the tractive force is in the magnetic separator. These separators are used throughout industry especially in handling bulk materials. For example, in the milling industry they are mounted in chutes over which grain must pass. Ferro-magnetic material as it passes down the chute is attracted to the permanent magnet thus preventing it from passing into the mills, which could cause damage to the mill, or even a fire. It also prevents the iron material from being passed on to the final product.

The principle is also used for indicating and control gauges. In many of these, two magnets are utilized. One magnet is placed on one side of a seal and the following magnet, with an attached indicator, on the other side. As the one magnet is caused to turn, the other magnet is so mounted that it follows. Thus, there is a transfer of motion from a sealed inner member to an outer member. Consequently, the hazards in case of volatile liquids or inflammable gases are eliminated. The outside magnet will indicate the level, or may be caused to actuate suitable controls or signal devices.

By utilizing more powerful magnets, actual power has been transmitted by this means. This power may be used for metering, or it may be used to drive a pump through a sealed member. Thus a magnetic drive through a seal is obtained.

Hysteresis drives:

One of the special classifications is the use of permanent magnet materials in hysteresis motors or drives. One permanent magnet is utilized to magnetize another permanent magnet, the latter magnet being of a smaller size than the energizing magnet. If arranged so that they rotate on separate shafts, they will turn in synchronism as long as the available torque is not exceeded. When the torque available is exceeded, there will be slippage. However, a constant torque will be developed between the two magnets regardless of the speed due to the continued change in magnetization of the smaller magnet by the larger. As soon as the torque required is relaxed, the magnets will again turn in synchronism.

This is also the basis of the hysteresis motor, except in this case, the rotating electrical field acts on the permanent magnet material to magnetize it and, if the torque requirements are not too high, the magnet will turn in synchronism with the applied rotating field, just as is the case in the synchronous motor. The difference is that if the permanent magnet material loses step with the rotating field, upon removal of the retarding force, synchronism will again be obtained, which is not true of a synchronous motor. This principle is also used for hysteresis clutches and various other devices.

Changing physical characteristics:

The last group—wherein a permanent magnet is utilized to change the physical characteristics of material—has been, to the present time, largely of only theoretical importance. Certain magnetic materials, when placed in a magnetic field, will change their dimensions. This principle has been used in the magnetostriction generators used for underwater signalling. A magnetic field will also cause certain materials, such as bismuth, to change their electrical resistance. Minute changes in the angle of reflection of light can be obtained by the application of the magnetic field. These and similar effects may eventually lead to further utilization of the magnet, especially in scientific work and possible control functions. END

Technical papers wanted for IRE Canadian Convention

The Technical Programme Committee is asking for papers to be submitted for the technical sessions for the I.R.E. Canadian Convention to be held in Toronto at Exhibition Park, October 8, 9 and 10, 1958. Papers may be submitted on any topic likely to be of interest to I.R.E. members, and it is not at all necessary for the author to be a member of the Institute of Radio Engineers.

Authors should submit the following, in duplicate:

1. A 500-word summary of the paper, from which the committee can judge the suitability of the paper for the technical program.
2. A 100-word abstract of the paper, suitable for insertion in the Technical Programme pamphlet if the paper is accepted.

It would be appreciated if the author would indicate the field in which the subject of the paper lies. It is expected that most of the papers submitted will lie in one of the following Professional Group categories:

Aeronautical and navigational electronics, antennas and propagation, audio, broadcast and television receivers, broadcast transmission systems, circuit theory, communication systems, component parts, electron devices, electronic computers, engineering management, industrial electronics, information theory, instrumentation, medical electronics, microwave theory and techniques, nuclear science, production techniques, quality control, radio telemetry and remote control, ultrasonics engineering, vehicular communications, military electronics, education, engineering writing and speech.

The summaries and abstracts should be sent to Mr. A. P. H. Barclay, IRE Canadian Convention, 1819 Yonge Street, Toronto 7, Ontario, not later than May 31, 1958.

The engineering writer, working closely with research personnel, can provide valuable liaison. Above, Bell Laboratories

Technical writing — part 2

J. KONIGSBERG*

Expanding the role of the engineering writer

The recent tremendous growth in the fields of engineering research and production has created the role of the Engineering Writer. Up to the present time his activities have been, for the most part, confined to the relatively isolated functions of handbook, brochure and technical bulletin preparation. In contrast to this, the function of the engineering writer is examined from a new viewpoint which sees him as an integrated, hard-hitting, effective, and full fledged member of a research or production project team. He can provide effective co-ordination within the organization

A recent editorial in one of the leading trade magazines devoted to automation and system control noted very sharply that whether we like it or not, the days of the one-man project team are gone forever. So far and wide has the universe of technical knowledge expanded that we have been forced into applying modern mass-production techniques to the research, development, and product design phases of any new piece of equipment in the same way these techniques have been applied to the actual production of the equipment. Where before it was possible for one man to shepherd a simple piece of equipment from the drawing board to the production line, now a project team of highly trained specialists is required to create and produce equipment which must embody the latest technological advances if it is to be competitive and useful. In a word, the day of the specialist is here, and it is here to stay.

The establishment of the reign of the specialist in the technological world has brought with it a basic need for better communication. This need is growing in magnitude as every new advance in technology is registered. The presence of an entirely new category of specialist in the research and engineering fields, called the Engineering Writer, more than emphasizes the recognition of this need.

Now the existence of the engineering writer per se should not be regarded as a strange phenomenon. On the contrary, it should be regarded as the natural consequence of a situation very common to our technology—one which is best defined by the expression "necessity is the mother

*Mergenthaler Linotype Co., Brooklyn, N.Y.

of invention." The "necessity" is the basic need for better communication; the "invention" is the engineering writer. Thus it is not unusual that we find the engineering writer present in the world of research and engineering where only a few years ago he did not exist.

Sometimes the basic need which generates the creation of an invention is not recognized as such, or the purpose of the inventor in creating an invention is to fulfill a need which is relatively minor as compared to the real and sometimes unknown or unrecognized potential of the invention. Thus the theory of complex numbers was established by mathematicians and lay dormant for many years before this "invention" was recognized as the most powerful and indispensable tool for the successful analysis of complicated problems of electronics and mechanics. In much the same manner, a careful examination and evaluation of the basic need of good communication brought upon us by the ever expanding universe of technology will reveal the full potential of the engineering writer. This potential is that of a full fledged, active, and integrated member of a project team of specialists—a member who specializes in promoting good and effective communication on both an oral and written level between the members of the project team and between the project team and responsible management.

An examination of the accompanying project organization chart will begin to give a bare inkling of what the active presence of an engineering writer on the staff of a project team can do for the successful functioning of this team of specialists. The solid lines on the chart illustrate the nominal organization of a project team in which the communication load centres upon the project leader. The latter is responsible for the coordination of the efforts of the staff engineers and for evaluating and reporting these efforts to management. Notice that within their own immediate group, the staff engineers are relatively isolated from one another and are entirely dependent upon the project leader for co-ordination and for first-hand knowledge of each other's efforts.

Usually the efforts of the project leader towards coordination and dissemination of related project knowledge among staff engineers takes the form of a weekly or monthly conference. If the project leader is burdened with administrative details or with his own immediate special work on the project, as is usually the case, staff conferences occur infrequently. The net result is usually a condition among the staff engineers where the right hand does not know what the left hand is doing. This undesirable condition is further amplified due to the very nature of the intensive and specialized efforts of each staff engineer.

In such a project-team organization as shown by the solid lines in the chart, the engineering writer may not be brought into the picture. If he is, it is usually at a time near the termination of the project, or shortly after project termination. At this time his services are called upon to aid in setting down in a formal report the efforts and accomplishments of the project staff. The writer's efforts are thus effectively isolated from the main stream of the project staff's activity, and his function is limited to one of recording for posterity the salient facts established by the project work.

Now take this same project organization and add a catalytic agent in the form of an engineering writer. The word "catalytic" has been deliberately chosen here to imply that something will take place in the functioning of the project team which formerly did not take place, even though all of the basic ingredients were present. This "something" is a strong bond of continuous communication between the staff engineers, and the bond is the engineering writer. This new organization is shown by both the solid and broken lines in the chart.

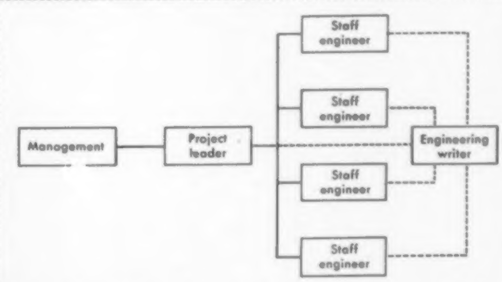
One of the main functions of the engineering writer assigned to a project team is to maintain a broad, objective, and over-all viewpoint of the project's activities. Another important function is to circulate the staff and solicit information on all activities for the purpose of report preparation. In this capacity, the engineering writer becomes one of the few persons connected with the project who is intimately aware of all phases of project activity. Because of his circulating activity, the engineering writer is in an excellent position to informally and objectively transmit project information to all members of the project staff. It is to be emphasized that such transmission takes place during the course of informal conversation occurring at the time of the information-soliciting tours. In this manner, the isolation walls set up around the highly specialized activity fields of each staff engineer are broken down, and a sense of unity and common purpose permeates the entire project.

As seen from the staff engineer's viewpoint, the engineering writer provides an ever present and convenient focal point of discussion for the staff engineer. This in turn encourages the free interchange of ideas among the staff and releases them from the inhibiting bonds always inherent in the highly specialized nature of their work. To sum up this last thought, the presence of the engineering writer encourages the staff engineer to trade his ideas in the open market place of free discussion. This kind of activity is a must for the success of any difficult project.

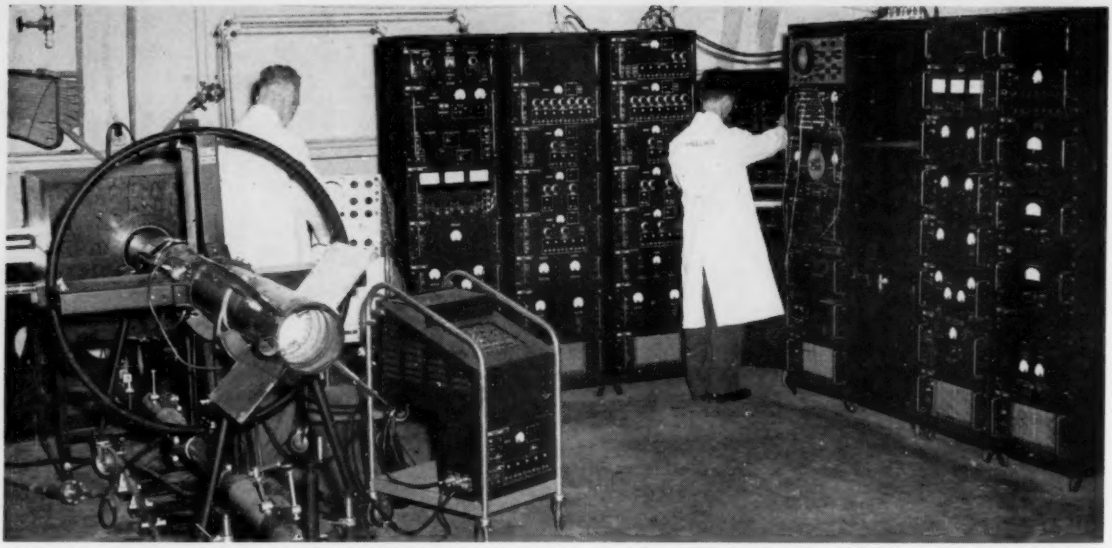
Thus far we have said very little about the writing function. It is a generally accepted fact that engineers abhor the task of report writing, and at best regard it as a necessary evil required to round out performance on the job. The reasons for this negative attitude are wide and varied and will not be discussed here, but there is no denying that such an attitude does exist.

Now, contrary to what is commonly understood, the engineering writer is brought into the writing problem situation not to eliminate report writing on the part of the engineer and thus sustain the aforementioned negative attitude, but rather to counteract this negative attitude and encourage report writing on the part of the engineer. This is easy to understand when seen from the engineering writer's viewpoint. Any qualified engineering writer knows that if he is to write a good report on project work done by a staff engineer, he must in effect induce the engineer to write the report. By this we mean that the writer must intelligently discuss, probe, and question the engineer to get the basic facts of the project work. At the same time he must establish through his discussions and questions the order of importance and implications of these facts. If he is successful in this objective, the engineering

(Continued on page 33)



Solid lines show organization of most research labs. Broken lines show how the writer can provide liaison



Complete missile, simulator and instrumentation setup in a development engineering laboratory at Canadair Ltd.

Simulators aid missile design, checkout

JOHN E. A. MORTIMER*

The rapid advance in the field of computers and simulators over the past decade has paralleled the development of missiles. The analogue computer is discussed in missile system design, along with techniques and philosophy of approach. The paper then enlarges upon the advantages of real time simulation in the design, checkout and evaluation of guided missiles. It shows how simulators can be of great importance in the final stages and reduce the number of expensive test firings

In the initial design stage of a missile program where the system requirements have been laid down, computer work is started to obtain preliminary data. Equations describing dynamic systems are approximated by linear functions, and from this information the approximate limits and parameters are established.

An analogue computer of conventional design working on an expanded time scale is quite adequate. The linear analysis will contribute materially to the understanding of the system, especially its stability. Such studies in both single and three-axis arrangements can be made at the outset of the design. If this is followed by an orderly approach of investigating the effect of individual variables with a gradual increase in the complexity of the analysis, an understanding of the problem should result. Here then, is the first example of the importance of simulation, where we have a direct yield of foreground and background information which is invaluable in the early gestation period of design.

The first thing to do is study large ranges of variables and find how to determine quickly their effect on flight characteristics. Later on parts of the system can be represented with high fidelity while other parts are studied. These can be represented with increasing realism by introducing second order effects into the problem one at a time, in order of their importance. Finally the entire physical system is carefully simulated with the greatest detail and authenticity that the computing equipment will permit.

At this stage of the program the degree of success depends very heavily upon making the maximum use of available computing facilities and the astuteness with which the physical system is approximated. The system may consist of target geometry, seeker system, autopilot, shaping networks, kinematics and aerodynamics.

The discussion so far has led up to flight simulation which duplicates the system as realistically as possible using normal computer techniques on an expanded time scale. The equipment used would include mechanical, electro-mechanical and/or electronic devices which when excited by external signals or forces corresponding to missile flight conditions, exhibit static and dynamic characteristics which are analogous to those of the missile system. In this manner relations involving extremely complex mathematics, or even exceeding the scope of mathematical analysis, can be investigated at a reasonable cost and within a comparatively short time. This is the second example of the importance of simulation.

Special simulator devices needed

The complexity and non-linear characteristics of missile system problems have generated a need for special devices which simulate such functions as underdamped quadratics and other transfer functions. This type of expression occurs mainly in the missile instrumentation, e.g. rate gyros and accelerometers. Special simulators are also built to represent the characteristics of autopilot components such as hydraulic actuators and valves, in which

*Canadair Ltd., Montreal.

phenomena such as mechanical backlash, valve hysteresis and deadzone have to be taken into account. These simulators are usually constructed to represent one particular item of the system under study with as high a fidelity as possible. High gain DC amplifiers with various configurations of resistance — capacitance networks in the feedback and input circuits are used in the building of this type of simulator. In the case of backlash and deadzone, various diode circuits are used to form an analogue of these phenomena. Although the above methods of simulation give a fairly realistic representation of the system or part of the system under consideration, and are very valuable for system analysis in some phases of design, they are in many cases just higher order approximations. In the latter stages of design the accuracy with which the system is represented is of prime importance and can materially affect the success of a program.

High fidelity representation of complex seeker systems and non-linear components becomes very complicated and in some cases almost impossible. In fact on some design programs in the past, trial firings of the missile have been undertaken to obtain the information that could not, with the computing equipment then available, be obtained by simulation. The data that these trials gave was limited by the telemetry system being used. These limitations include accuracy, number of functions being monitored and telemetry reliability. Apart from the expense and time consumed by these trials, the data return was of a nature not particularly suitable for the detailed analysis and evaluation of the system. We are not of course saying that trial firings are not necessary at some stage of the design program, but we shall attempt to indicate how some of the trials can be eliminated, and more exact data obtained, with the methods of simulation using actual components on a real time basis outlined in the remainder of this discussion.

Here is the third example of the importance of simulation. A good simulator skillfully used, can reduce the field trials component of a design and development program quite substantially.

Flight simulators use real time base

In recent years with the development of guided missiles various flight simulators have been built to work on a real time basis. They vary in size and complexity as do the missiles for which they were built. Figure 1 illustrates a simulator designed to perform two-fold duties; one was complete missile simulation and the other was checkout of complete missiles or individual sections of the vehicle in simulated flight conditions. In the case of complete missile simulation the individual transfer functions of the various missile sections such as the guidance unit, autopilot, hydraulics, accelerometer and rate gyro feedbacks and also the aerodynamics and kinematics were simulated in separate units. The types of problem investigated with this arrangement were: Stability and Response Characteristics, Launching transient effects and simple cross-coupling phenomena.

In the case of actual missile checkout and evaluation the individual simulators representing the guidance unit, autopilot and hydraulics were replaced by these missile sections. The aerodynamics and kinematics, accelerometer and the rate gyro feedbacks remained simulated.

Provision was made for target simulation which consisted of a radar horn and microwave power source which incorporated provisions for closing rate and acceleration. The horn and guidance unit antenna were enclosed in an anechoic chamber. The horn was actuated in a horizontal plane by an electro hydraulic servo, which was fed with angular error information to complete the homing loop. Before discussing the limitations of this flight simulator

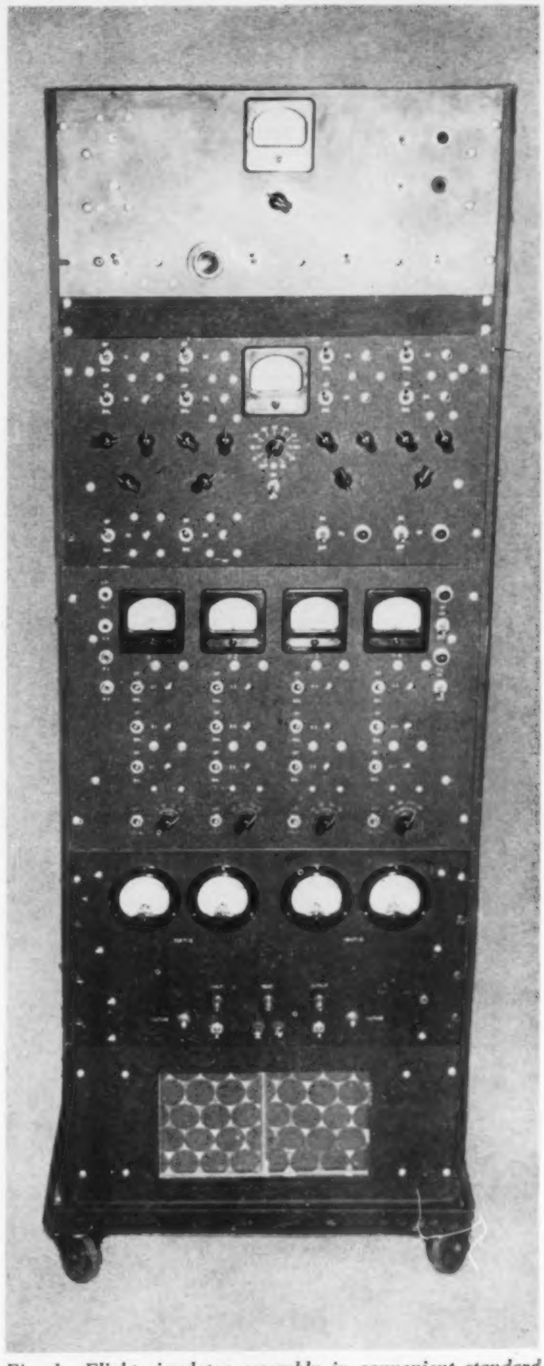


Fig. 1. Flight simulator assembly in convenient standard rack includes roll and hydraulic actuator simulators

let it be said that this equipment was an invaluable tool in the missile program for which it was designed and that it provided excellent experience in this field. It simulated the three planes of the missile, e.g. pitch, yaw and roll in three separate computer channels, with fixed angle resolution.

This made it virtually two-dimensional; an effort was made to incorporate an electro-mechanical roll table with the roll rate-gyro mounted upon it. Sine and cosine

potentiometers were to be driven from this table but it was found, as is nearly always the case with this type of servo, to be too slow in response for the roll loop characteristics at the particular altitudes and Mach numbers of interest. The roll rate-gyro transfer function was therefore simulated electronically along with the roll aerodynamics. This, of course, limited the set-up to fixed angle resolution.

Hydraulic actuator simulator

The aerodynamic transfer functions were simulated in a linear form; linearization of the aerodynamic equations was reasonably adequate for this type of equipment when the other limitations were taken into account, but simulating the aerodynamics in the form of transfer functions made changes in aerodynamic parameters difficult. The reason for this was, of course, that a change of one aerodynamic parameter such as mass for instance, changed all the transfer function coefficients, which meant that new tables of coefficients for altitudes and Mach numbers had to be calculated. If, on the other hand the aerodynamic equations had been represented on the computer in a differential form, i.e. a differential analyzer, change of one parameter then would have only changed one of the coefficients; in the particular case mentioned above, one potentiometer could have been calibrated in mass. In passing, it can also be mentioned that differential analyzer techniques usually avoid the use of differentiators with their inherent of bad characteristics, i.e. H.F. noise and instability.

A better simulator for the hydraulic actuator was constructed and this was used with the missile electronic control package which afforded an excellent check on this package without having to use the missile's hydraulic section, thereby minimizing the risk of damage to this section and reducing wear and tear. The hydraulic simulator had a second order transfer function and incorporated non-linear functions of deadzone and backlash, which were made variable for each wing of the missile to enable any combinations of these effects met in practice to be set up.

Although this flight simulator was obviously a very valuable tool, it became quite evident that a more versatile and extensive unit was needed which would not have the restrictions previously discussed and would incorporate these further points.

(a) Motion sensitive components had to be simulated, e.g. accelerometers, and roll rate gyros.

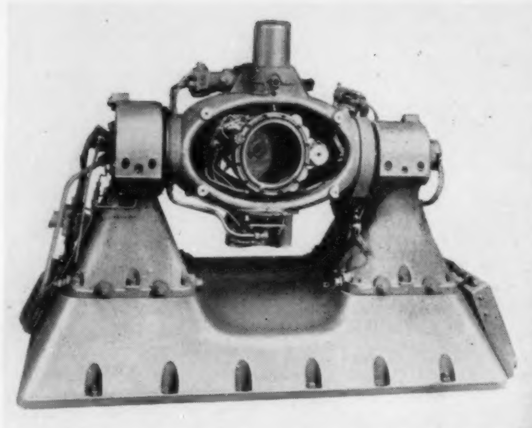
(b) Problems such as:

1. The effect of target noise on trajectory and miss distance.
2. Trajectory and miss distance data.
3. Aerodynamic and radar cross-coupling.
4. Counter-measure susceptability.

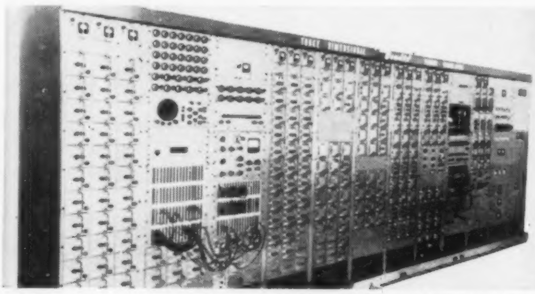
For the solution of these types of problem three-axis simulation using missile hardware is essential.

In the simulation of complex non-linear functions in real time, products, quotients, squares, absolute values and vector resolution have to be performed electronically, due to the narrow band width and, hence, response of electro-mechanical servos.

There are now many types of electronic multipliers available. Among the best, from a band width and accuracy standpoint, are the recently developed time division units. Electronic resolvers and the other mathematical operations listed above can be performed by suitable arrangements of multipliers, operational amplifiers and integrators. A complete three-axis arrangement can be built using the above techniques but there are still the problems of incorporating motion sensitive components



Bendix three-axis flight table has hydraulic driven servo controlled gimbal system which operates in real time



Electronics unit associated with flight table simulates high-speed missile kinematics and commands servo drives

in the circuit; this applies to seeker systems as well as rate gyros and accelerometers. As a solution to this problem a three-axis flight table has been developed by Bendix Computer Division. This table consists of a high performance, hydraulic driven servo controlled gimbal system, which responds to command inputs from an analogue computer (on a real time basis). Motion sensitive missile sections and components mounted upon these gimbals are subjected to the torques, angular accelerations, and angular velocities which would be experienced in actual flight conditions. Instruments mounted on the gimbal system monitor position and velocity, and compute Euler angle transformations, which are fed back to the analogue computer. The table and the test piece form elements of the closed loop system. The response of the table is fast enough so as to have negligible effect on the system being simulated. However, details of this unit are readily available in the industry, therefore we need not concern ourselves with them any further. The inclusion of the table saves much computing equipment, and the computer is, as indicated, completely electronic.

Open or closed loop tests can be made with this equipment. Investigations with a seeker mounted upon a table can be accomplished with either a fixed or movable target. A movable target would be necessary for the type of analysis work outlined previously, that is trajectory and operational evaluation simulation, etc.

The construction of a movable target simulator appears, and is indeed, quite a formidable task, especially if it is to move in two planes; and some problems are

such that this may be a possible requirement. The response of this target simulator must approach the same order of magnitude (in translation) as the flight table has response in rotation; this is mainly due to the requirement for parallax correction. With such a target simulator all the closed loop studies of stability and trajectory, with a physical guidance unit can be undertaken.

To produce such a target simulator would need quite a development program but it is deemed to be of such importance that it is hoped this will be accomplished.

Real time analogue-digital hybrid simulators

Fast digital techniques have been and are being developed which give promise of possible analogue-digital hybrid simulators working in real time. This possibility indicates that a great improvement in accuracy will result with this type of hybrid.

There are, in fact, analogue-digital and digital-analogue conversion units available commercially which actually operate on the input functions with variables. These units will work in real time having a reasonable band width for most applications. The advantages of increased accuracy, possible saving of the number of operational amplifiers required in an analogue set-up and the capability of open loop integration should give impetus to the development of the hybrid computer.

The design of a flight simulator in the class that we have been discussing should be as versatile and as general in nature as possible, so that its use is not confined to one particular type of missile.

The capability of high fidelity flight simulation using actual missile parts can save much time and what is more important, can produce accurate data relatively quickly that could only have been obtained by trial firings of the vehicle. It is indicated therefore that trial firings can be reduced thereby either reducing the number of test rounds required or making the rounds that would have been fired available for other purposes. Not many trials would have to be saved to pay for the initial cost of such a flight simulator. This, coupled with the obvious speeding up of the program should make it quite an attractive proposition for a large scale missile development establishment. Of course we must not lose sight of the fact that this type of simulator is very costly and takes considerable time to build. There must always be a crossover point in the cost curves for simulation and field trials where the simulator begins to pay off.

Simulating missile aerodynamics is difficult

The problem of simulating accurately the aerodynamics of some missiles is quite difficult, making heavy demands on the ingenuity, experience and ability of the engineers concerned. In this particular case, unlike the rest of the system where the actual components of the missile can be used, the aerodynamics have to be simulated, and to simulate them they have to be known. These data are supplied by the aerodynamicist who supplements his calculations with wind tunnel tests and aerodynamic test vehicle trials. With reasonably accurate aerodynamic information available a simulation can be accomplished. The computer setup will be complex, demanding many computer elements such as operational amplifiers, integrators, multiplifiers and special function generators, but the problem is certainly not insurmountable.

A fifth example of the importance of a real time flight simulator is in the possibility of flight duplication of an actual missile test vehicle from recorded telemetry data. That is, recorded functions, such as wing deflections, would be fed into the computer and a comparison made of the resulting simulated flight with the actual flight. Of course, in an arrangement of this type you are at the mercy of the accuracy of the telemetry system. But it would serve as a rough check on the results obtained at the trial; for instance a correlation between the lateral acceleration obtained on the simulated flight with that measured during the actual flight, might be obtained.

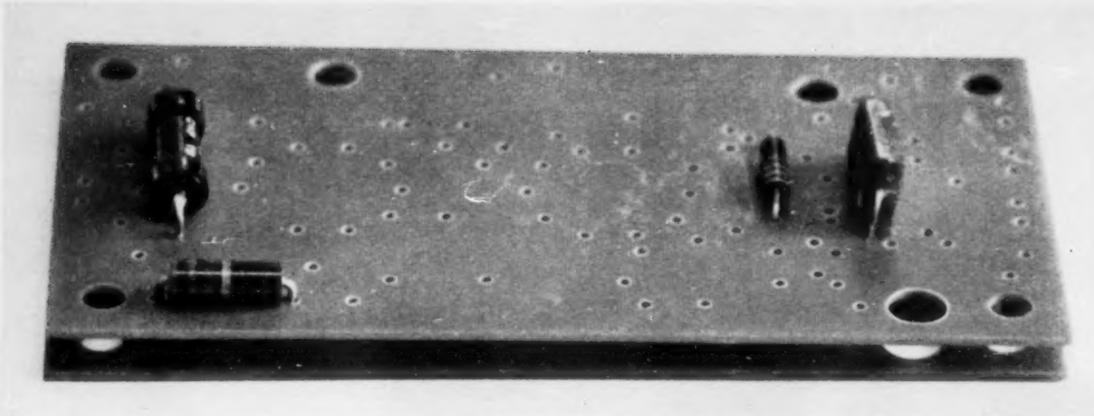
A sixth and most important point, and one which has not yet been fully explored, is the use of simulation of flight under simulated environmental conditions as a means of studying reliability. Clearly, this technique fits to very late stages of missile design and development where its impact could be enormously beneficial. END

Expanding the role of the engineering writer

(Continued from page 29)
writer has indeed induced the engineer to do the basic "writing" of the report. It now remains for the writer to exercise his specialty which is to organize the given material into an orderly and lucid written presentation.

It must be stressed that the writing of the report is thus a co-operative venture, actively participated in by both the engineering writer and the staff engineer. Under such an arrangement, the staff engineer can develop a positive attitude towards the report writing task, and can see the function of the engineering writer as that of a valuable aid in the performance of his, the engineer's, job. The creation of this positive, co-operative atmosphere by the engineering writer encourages the staff engineer to make further use of his new-found aid. The net result is that report writing is encouraged rather than avoided. How much this means in terms of the effectiveness and achievement of a project team's efforts is difficult to estimate, but one can only begin to guess by thinking of the number of good ideas which have never seen the light of day simply for want of expression in a well written proposal.

Finally, consider the function of the engineering writer from the viewpoint of management. Any successful and progressive management knows that if it is going to get productive results from its project teams, it must give these teams adequate tools to work with. Nothing discourages and hinders fruitful research and production project work more than poor laboratory facilities and a scarcity of equipment. Ample testimony that responsible management recognizes the truth of this statement is given by the millions of dollars annually spent by management to provide its project teams with the most advanced facilities and equipment. In line with this thought, we are suggesting that the addition of an engineering writer to a project staff gives the project team a highly effective tool to aid in the successful attainment of project objectives. The obvious presence of the engineering writer on the project staff provides a constant, positive, but subtle impetus for all staff members to carefully define, co-ordinate, and evaluate their respective project activities. Thus, while fulfilling his immediate function of report writing, the engineering writer does something that no laboratory facility or equipment can do, and this is to unobtrusively aid the project leader in his efforts to drive the project team to a high productive level. END



Composite view of the two parts of a twin-deck assembly. Separation of the boards is normally less than shown here

Twin-deck system replaces two-sided printed circuit boards

T. W. DENZEY, ASSOC. BRIT. I.R.E.*

A new approach to printed circuit board design uses two single-sided boards as a "sandwich" in place of a two-sided board with plated-through holes. Advantages claimed for this type of construction include greater reliability and the possibility of applying automatic assembly methods economically, even to small production quantities.

Some years have elapsed since printed wiring was first used in the electronics industry. During this period a pattern of use has emerged on which may be based comparisons of different designs. One school of thought has even favored a return to point-to-point wiring for certain applications, basing their objections to printed circuits on considerations of reliability.

Three principal factors affect the reliability of printed circuit board assemblies as used in missiles and other military applications: the basic laminated material used; the soldered joints; and the resistance of the assembly to shock and vibration. Studies over a period of five years in our plants and others have made it clear that the use of single-sided boards is the best answer to reliability. This conclusion has been supported by the results of test firings involving equipment using printed wiring of both single- and double-sided construction.

Bearing the above conclusion in mind and also considering the factors of space-saving, accessibility in the end equipment, and quick changeability in the field, a new solution has been found to the problem of the engineer whose circuit requirements and available space cannot be satisfied with simple single-sided boards.

This system, known as "Twin-Deck," uses two (or more) single-sided boards. In the manufacture of a two-board twin-deck assembly, the upper "component-bearing" board is processed in the usual manner, but with the circuit on the underside of a copper-clad board of half the thickness required. Component designations may easily be added by silk-screening on the upper side of the board. The second circuit pattern is similarly processed on the underside of another board of the same thickness. Although design work is not necessarily shortened, the arduous thinking involved in "reversal" for the underside pattern is eliminated.

The components are then inserted from the top of the first board—see fig 1a. This top board is then ready for automatic dip soldering on even a small scale assembly line. The component leads are cut short enough to just pass through the second board, the holes in which are countersunk to receive the solder fillets of the top circuits. The boards are placed together and the second dip solder operation is performed. No solder flow up the holes is required—see fig 1b. The two boards may be clamped together, but this is not essential in a well-designed unit. If necessary, the assembly may now be encapsulated.

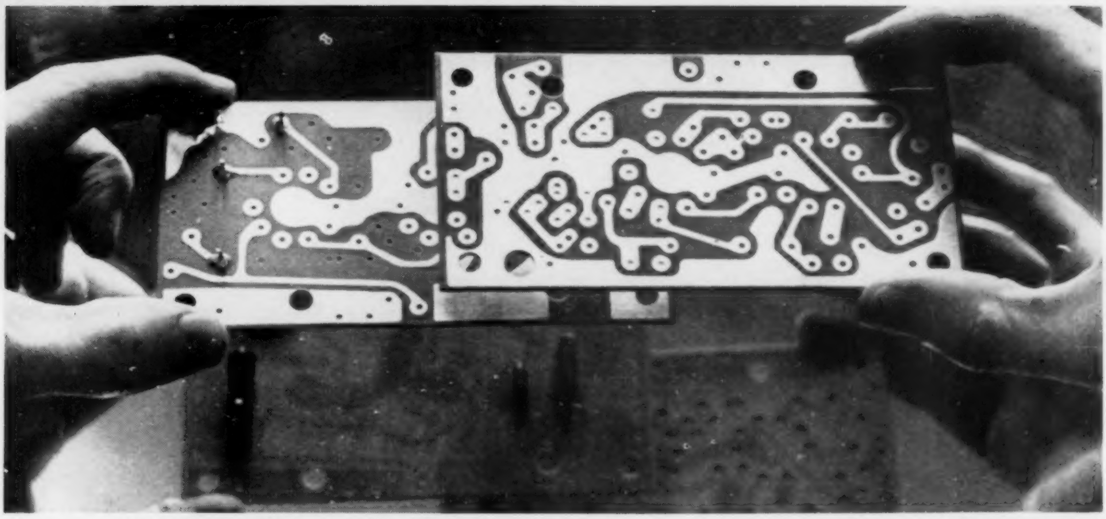
Advantages of twin-deck

It is claimed that this new system is neat and simple, offers flexibility, and can be made at less cost than equivalent two-sided boards with plated-through holes. The following specific advantages are evident:

(a) Expansion or contraction of the laminate with ambient changes cannot affect the circuitry.
(b) Ample area for marking component designations.
(c) Contacts for insertion type connections can be plated separately and then assembled, eliminating selective plating of the contact fingers.
(d) No fretting of components on wiring, eliminating the need for protective sleeves.
(e) Automatic assembly on even a small scale is possible.
(f) Inspection and correction of errors may take place after the first board is soldered.
(g) The assembly has very good resistance to shock and vibration, particularly since components are not held too rigidly.
(h) Space requirement is only 1/16 to ⅛ inch at most greater than for two-sided board.
(i) Amount of wiring may be increased by adding decks.
(j) Defective components may be changed very easily.

END

*Allied Circuit Techniques Ltd., Oakville, Ontario.



The two parts of the twin-deck assembly before the second solder dip. Note beads of solder which fit into countersunk holes. Reverse image of printed wiring seen in reflections is caused by light transmitted through the thin boards

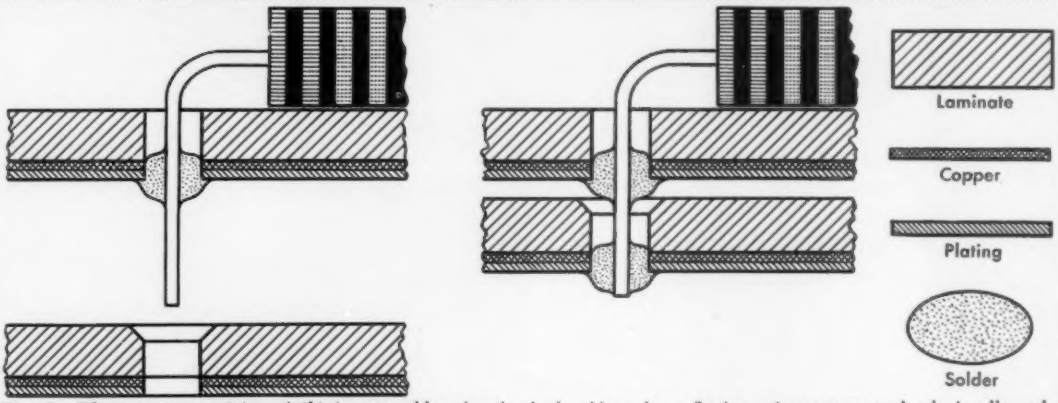
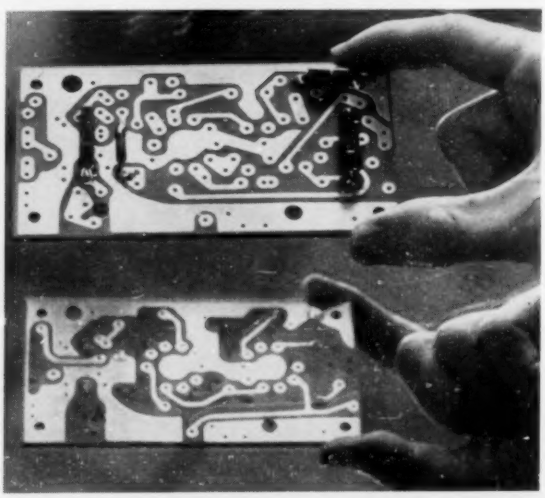


Fig. 1. The two stages (a) and (b) in assembly of twin-deck. Note how flexion of component leads is allowed



Mirrored view of top and bottom of a typical two-sided board with plated-through holes. Little space is available for marking component designations on either side

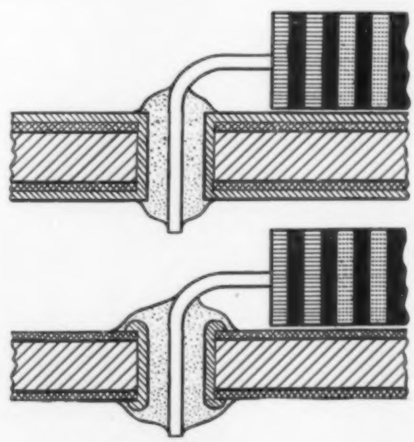


Fig. 2. Two methods of through hole plating. Component sleeves may be necessary to prevent abrasion

Edmonton ham wins CD contest

W. M. Whitley, VE6BN won the prize in a papers competition sponsored by Radio College of Canada and launched through Civil Defence HQ in Ottawa. CEE presents here the full text of the winning paper.

Mr. Whitley (right), who is radio communications supervisor with Canadian Utilities Limited, Edmonton, is congratulated by Hon. L. C. Halmrast, Minister of Agriculture and Civil Defence, Alberta. Prize is transistor chronometer and tuition to value of $895 from R.C.C.

Part 1—The ideal mobile rig for emergency communications

The factors governing the ideal mobile transmitter for amateur frequency working pleasure and the prospect and readiness of that transmitter in time of emergencies must take into consideration the terrain in which the vehicle is likely to be working and the possibility of atmospheric conditions causing distortions and fades over a 100 mile diameter distance. With this in mind, the writer is using the Edmonton area coverage for a mobile transmitter to meet to the greatest extent possible all conditions that may arise. This brings out the following facts:—

1. When using the ground plane antenna on vehicles to work into a main station, the signal is subject to being carried by the sky wave. This causes fades and distortions at distances greater than 60 miles from the main station — using 75 metre frequencies.

2. The adverse conditions that can prevail at the receiving station due to atmospheric conditions (lightning, QSB, etc.) and local noise problems.

For amateur frequency working for pleasure the above two conditions are not too serious since the station can shut down. But under emergency conditions the transmitter must be kept on the air for emergency traffic handling and to get the message through. For maximum coverage, therefore, the transmitter must provide 100 watts output to the antenna, in order to ensure signal reception. The following additional considerations for such a mobile transmitter are proposed.

In modern mobile transmitters, certain functions must be sacrificed if others—such as ease of loading the antenna — are to be fully available. To incorporate all functions and give the greatest possible signal into a main station under the poorest operating conditions, the following recommendations are made.

A. The transmitter should be mounted in the trunk of the vehicle.

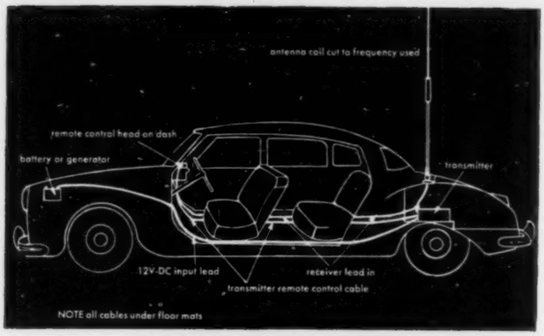
B. A remote control head should be mounted on the dashboard of the vehicle with an on-off switch for primary voltage, microphone with press-to-talk switch for high voltage power supply control, and antenna change-over relay control. The remote control lines should be run from the control head under the floor mats down the centre of the vehicle to the transmitter control connector, as shown in the drawing.

C. Frequency Coverage. The transmitter should be capable of coverage from 1700 kc to 14 mc, either by crystal control or a variable frequency oscillator. This frequency range is necessary to cover both the amateur frequency bands and some of the commercial frequencies up to 7 mc in this area. The transmitter should also have built-in band-switching facilities.

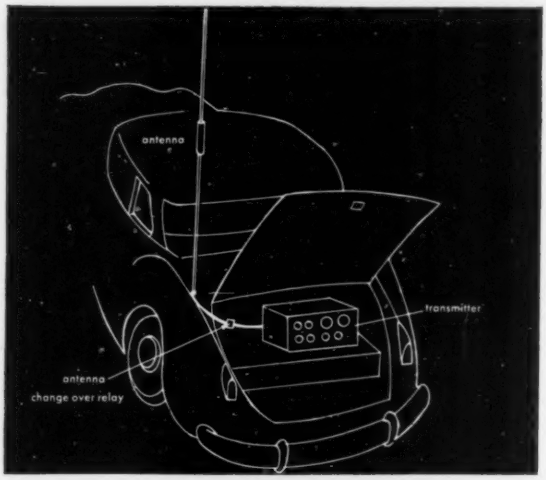
D. Loading of the antenna from the final tank circuit should be a Pi-network.

E. The antenna change-over relay for transmitter and receiver should be located between the transmitter output terminal and the antenna.

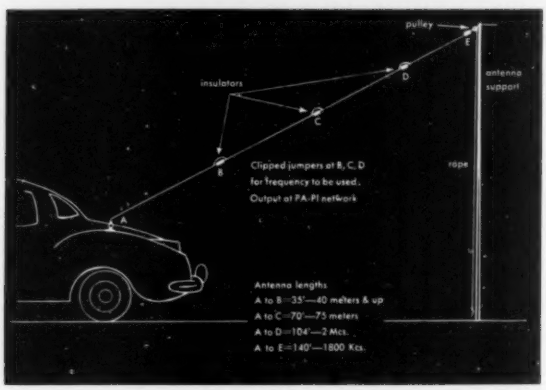
F. Antenna. The mobile antenna should be of the whip variety mounted on the rear trunk channel and as high as possible. There should be an individual centre-loaded coil resonating at each frequency used. This will require coil changing, but better signal results will offset the disadvantage of the slight time delay. An emergency antenna of the inverted-L or long wire type should be carried coiled-up. When it is to be used the whip should be taken down and the antenna end connected to the spring base of the whip. The other end should be attached to a convenient tree, pole or building. This antenna should be cut in one piece from No. 12 copper wire but insulators should be inserted and



General arrangement of supply, control and r-f cables



Change-over relay located between transmitter & antenna



Emergency antenna designed for wide frequency coverage

jumpered for each frequency used — see drawing. This emergency antenna should be used whenever the vehicle is stationary and the conditions are poor.

G. Power Supplies. The transmitter should have two power supplies: a vibrator or dynamotor supply for 12 vdc input and the other for 115 vac input. The ac power supply will allow the transmitter to be used on a local alternating current source or an emergency standby power unit when the vehicle is stationary. The ac supply could also be derived from a generator mounted on the vehicle's engine and driven by the fan belt. Suitable generators are now on the market.

H. Receiver. This unit should be mounted under the dashboard with good visibility for tuning. The frequency coverage should be by bands from 500 kc through to 14 mc. The power supply for the receiver should again be of a dual nature using 12 vdc and 115 vac inputs. The receiver antenna lead-in should be brought from the antenna change-over relay in the trunk to the receiver input terminal. This will decrease ignition noise pick-up from the engine.

The writer's main reason for having transmitter frequency coverage starting at 1700 kc is that the lower the frequency used the greater the effective coverage that can be gained. This is most noticeable with frequencies in the 2 mc region and lower.

Part 2—Co-operation between CD units and radio amateurs

Many, many times have the amateur radio operators, together with their main stations, portable units and mobile radio equipment stepped in to fill the gap for commercial communications when land line systems have failed due to traffic over-loading or damage by storms, etc.

In time of war or disaster the commercially operated telephone and telegraph companies will either be disabled or over-loaded with traffic handling both by the public and their own company's administration. This also will hold true for commercial radio networks working from outlying points into Edmonton, such as the Alberta Forestry Branch, oil companies, public utilities, etc. They will be overworked with their own problems to iron out but will, of course, make available their facilities when possible. However, it is here that the amateur radio operator can step in and relieve these networks of the burden and speed up disaster traffic.

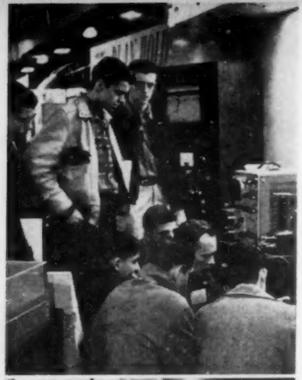
The amateur radio operator should know all lines of communication into and out of his particular area. He will then be able to inform the Civil Defence Director in his municipality that he is ready to handle traffic into and out of his station. The public communication systems may not necessarily be in his direct area and in the main the public services networks are using vhf frequencies. This leaves him on his own to put traffic through to Edmonton on the amateur frequencies or on frequencies allocated by the Canadian Civil Defence Headquarters.

All amateur radio operators at each station must be able to handle traffic on cw to allow for long-hop traffic handling when atmospheric conditions are poor.

It is known in the Alberta area that atmospheric conditions can change very rapidly from good to poor. The amateur radio operator must be prepared to relay messages when poor conditions prevail, or be in a position to move out to a disaster area with his mobile equipment to set up a relay station or act as a main station. The frequency coverage of his mobile equipment should allow him to work into the medium frequency networks of the known commercial companies in the disaster area.

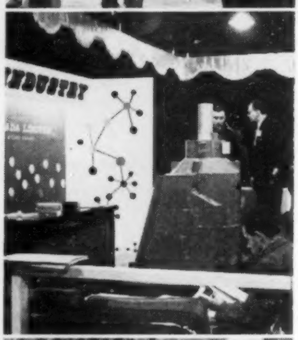
The amateur radio operator should have an auxiliary alternating current supply in case of main source power failure to enable his equipment to stay on the air. He should also have trained two or three other people to operate his equipment and handle messages. They can then relieve him at the operating position during the long hours that it may be necessary to have his station on the air.

The above are a few thoughts and observations by the writer which have arisen from working other amateur stations from his home position or from his car mobile unit. END



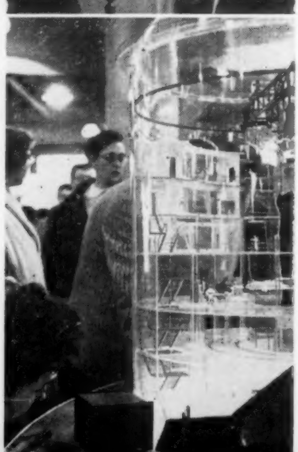
Students take close look at spectrometer in the Hamner Electronics booth.

H. Lodge discusses features of High Voltage Eng. 10 Mev tandem accelerator

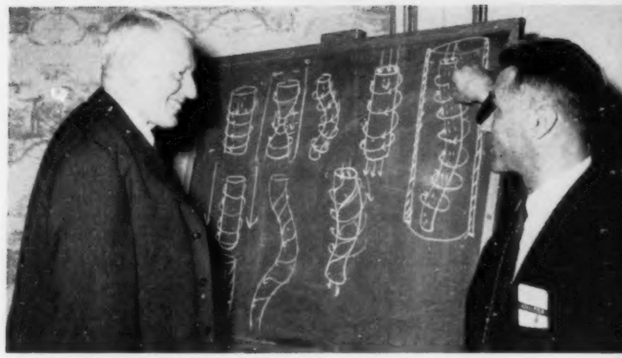


Atomic Energy of Canada Ltd. caught attention with their new gammacell 220

M. J. McNelly of CGE (r) discusses fuel element design with P. H. Reinker of GE



Model in plastic at NDA Complete Reactor Co. of nuclear station in operation



Sir G. Thomson (l) discusses some problems involved in controlling thermonuclear reaction with Prof. W. H. Bostick

Electronics at the

There is every prospect of extracting energy directly by "electronic techniques" from thermonuclear reactions, but don't expect to see scientists achieve a net power gain from these machines within the next 20 years. These were the cautious predictions made by Sir George Thomson, speaking at the 1958 Nuclear Congress in Chicago. He emphasized, however, that this field is so new it is virtually impossible to make accurate predictions.

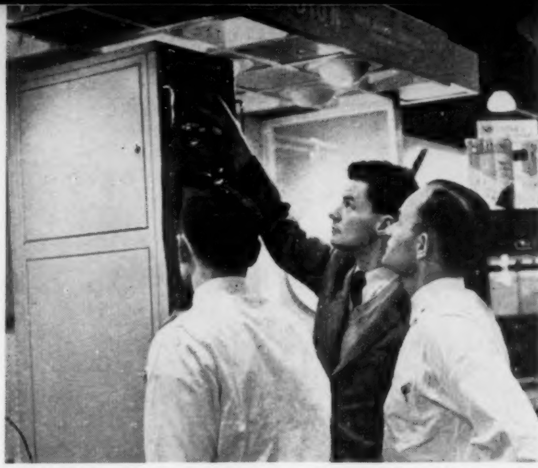
Sir George, now Master of Corpus Christi College, Cambridge University, was one of the original English scientists to undertake studies on controlled thermonuclear reactions. Some of his ideas set down in 1946 lead to the success of Zeta and Sceptre III.

These machines use the closed circuit or torus approach as opposed to the straight tube approach tried in some of the American and Russian projects. In effect, the torus containing the heavy hydrogen (deuterium) forms a single turn secondary winding of a large transformer. Current from a capacitor bank is fed to the primary windings surrounding the torus, and the induced current heats and ionizes the gas. Also surrounding the torus are smaller coils to provide the magnetic field that pinches the gas plasma into a thin stream. This can bulge, kink, or become fluted, but such instabilities which plagued early experiments have been overcome to a large extent.

The main problem, then, appears to be that of obtaining higher temperatures within the plasma. As the temperature is raised, the number of thermal reactions increases, until a state is reached (in the region of 500×10^6 C for deuterium—deuterium reaction) where the reaction will become self sustaining.

To reach this high temperature more current must be applied to the gas to provide ohmic heating. However, when you consider that the gas is so completely ionized that its conductivity is about 100 times better than copper, you begin to realize the problem.

Zeta uses a current up to 2×10^5 amperes in the gas to reach temperatures of the order of 5×10^6 C. But the important thing about Zeta, said Sir George, is that the design can be scaled up. They are, in fact, planning to add more capacitors to the primary system to get higher current.



L. Phillips, centre, from Computing Devices of Canada, gives last minute adjustment to 100-channel kicksorter

Nuclear power is expected to become economical through use of uranium oxide . . . Dr. W. B. Lewis, vice-president AECL

1958 nuclear congress

IAN R. DUTTON, ASSOCIATE EDITOR

It may also turn out that slight impurities in the gas will assist them to achieve higher temperatures through ohmic heating than the theory would indicate. But they won't know until they try it.

Nuclear Congress was comprehensive

The 1958 Nuclear Congress, made up of three conferences and one exhibit, was held in Chicago during the week of March 17. There was sentiment attached to the opening ceremonies. Less than 16 years ago, on December 2, 1952, Enrico Fermi and his colleagues achieved man's first self-sustaining nuclear chain reaction on the University of Chicago campus. A piece of the original fuel, still radioactive, was used to trigger a mechanism that cut the ribbon and opened the Congress.

The theme this year was "industrializing the atom." This was particularly evident in the Management Conference where they discussed the future markets for large and small power reactors, problems and prospects of selling outside the United States, governmental controls, nuclear propulsion of ships, indemnification, uses of radiosotypes, and thermonuclear research.

Despite the fact that the Americans had a technological advantage four to five years ago (greatly reduced now) they were never really able to invade the European markets. This should not be construed as lack of interest or ability on the part of the U. S. industry. While there has been a great deal of interest in the European countries, it can't really be claimed that markets existed. The cost of nuclear reactors is high and there still is a lot of uncertainty as to the most desirable type of reactor for any given set of conditions.

Electronics faces stiff competition

Unfortunately, the outlook is not too bright for the electronic equipment associated with nuclear reactors and research equipment. European customers often prefer to buy locally to support the home industry and conserve dollars. Buying locally also gives them a ready source of service and replacement parts.

Add to this the fact that Canada really is an importer of instruments, and you see that we are not serious contenders on the world market. Considering all types of instruments, Canada produces only 10% internally, and of her imports, 95% come from the United States.

This is one reason it was so gratifying to see the interest being shown at the Bendix booth in the Atomfair. On display was the 100-channel pulse-height analyzer built by Computing Devices of Canada Ltd., Ottawa. This transistorized kicksorter, designed for nuclear spectrum measurements, is expected to find applications in other industrial and commercial fields. In the oil industry, it can be used in the search for oil-bearing strata. In metallurgical applications, it can be used to identify minute traces of elements in metals and alloys; in medicine to check the purity of radioactive isotopes for therapeutic purposes.

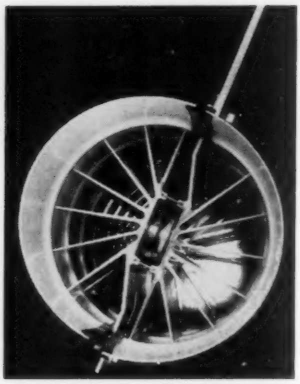
The kicksorter was originally designed at the Electronics Branch, Atomic Energy of Canada Ltd. Computing Devices of Canada did the final production engineering and are now manufacturing it for domestic and export sales. Five of them have been purchased by Bendix for sales demonstrators and one of these has been sold already to the National Bureau of Standards, Washington. Also, it was announced during the show that the instruments would eventually be manufactured under license at the Cincinnati division of Bendix for sale in the United States.

The Atomfair exhibits included a number of other types of electronic equipment. Transistors and other semiconductors devices were quite in evidence among the power supplies and some of the test equipment. This indicates that experience has been gained on reliability of these components under various operating conditions and the results have been favorable.

Another interesting display appeared at the High Voltage Engineering Corporation booth. They had a model of the 10 Mev tandem Van de Graaf particle accelerator scheduled for installation at Chalk River later this summer. The machine is nearing completion at their plant and will be assembled there first for preliminary tests. It will then be dismantled and moved to its final site. This probably will be the first machine of its type to go into operation but there is a bit of a race involved. A similar machine is being built at Harwell.

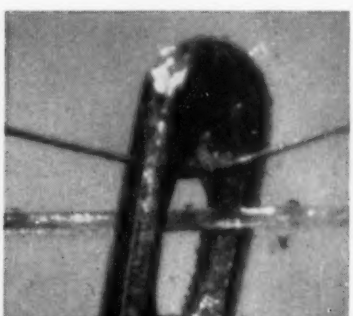
What's new in view

Scientists study levitation

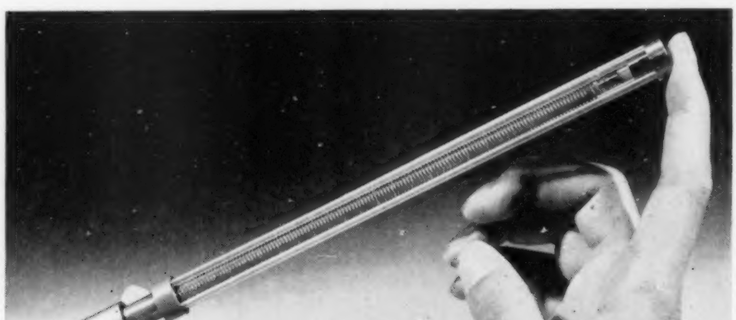


No satellite! Just fins for double sided cooling of General Electric germanium rectifiers

Small ingots of niobium, zirconium, titanium and other alloys are heated to extreme temperatures while suspended in space. This avoids problem of vessel melting or contaminating the ingot. Work is in Westinghouse laboratories



Human hair dwarfs two strands of insulated magnet wire made by Hitemp Wires. Eye is No. 10 needle



Many changes have come since first traveling wave tube was made. RCA researchers have replaced external electromagnetic focusing equipment with spiral bifilar focusing windings visible through side of tube

Contamination of injection fluids is prevented at Philips-Roxane Co. by working in sterile chamber under ultra-violet lamps. Philips Technical Review took photo

Atlas ICBM blasts off for test flight from Cape Canaveral. Missile is made by Convair Div. of General Dynamics

Using standard motion picture projection equipment, scientists engaged in high-temperature studies at the research labs of National Carbon Co. have developed a carbon arc image furnace. It produces a small but extremely high energy level beam to heat materials above 7,000 F

For your library

Historians can teach engineers how to search out information

The Modern Researcher

Jacques Barzum and Henry F. Graff. Harcourt, Brace and Co. (Longmans, Green & Co., Toronto); 386 pp; $7.00.

As the authors state, "The book is for anyone who is or will be engaged in research and report writing, regardless of his field of interest."

The reader might think he has picked up the wrong book when he scans the first few pages, but the authors have made no mistake. They cite the work of the historian for the chapters dealing with finding and verifying information. For there is no more diligent researcher than the successful historian. Scientists would do well to learn his methods.

Despite the fact that many of us have spent countless hours in libraries, at school, at university, in the company, or elsewhere, few know how to find all that can be found in one of these mines of information. The authors have done a good job of explaining how to get all that you seek.

Searching out the information, however, is only the beginning. It represents a major part of the time and effort in any project, but succeeds in informing one person only — the researcher. After that follows the process of placing the information on paper. Again the authors have done a good job of explaining how to organize the work, write in clear style, use footnotes, etc.

To write a short review about a book that contains so much information seems rather futile. Without doubt, however, this book will give the researcher a great deal of assistance . . . and it's quite entertaining besides.

Queues, Inventories and Maintenance

Philip M. Morse. John Wiley & Sons, Inc., New York; 202 pp; $6.50

Subtitled "The analysis of Operational Systems with Variable Demand and Supply," this is the first book in a new series on operations research.

Motion and Time Study

Ralph M. Barnes. John Wiley & Sons, Inc., New York; 665 pp; $9.25

The fourth edition of this book on the principles of motion and time study has five new chapters. They deal with motion study, mechanization, and automation; mechanized time study and electronic data processing; systems of motion-time data; evaluating and controlling factors other than labor; multi-factor wage incentive plans; work sampling.

IRE National Convention Record — 1958

All available papers presented at the 1958 IRE National Convention will be issued in 10 parts, with each part devoted to one general subject. Members of IRE Professional Groups, paid by April 30, 1958, will receive free of charge that part of the Record pertaining to their group. Other Parts may be purchased by members and non-members at nominal fee. Full information may be obtained from the Institute of Radio Engineers, 1 East 79 Street, New York 21, N.Y.

Catalogues and brochures from the manufacturers

Progressive speaker expansion for Hi-Fi systems tells how systems can be started with few basic parts and expanded later. Four-page folder. University Loudspeakers, Inc., White Plains, N.Y. (101)

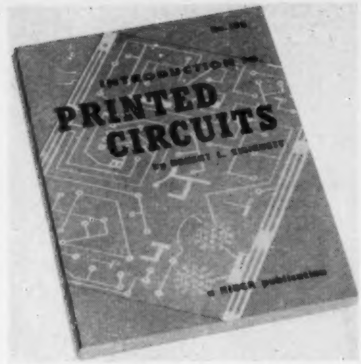
Canadian Applied Research Ltd. services and products are described in new 20 page brochure. (102)

Tape it off the air. Eight page folder gives detailed instructions on how to rig a tape recorder to make good recordings from am or fm radio receivers or TV sets. ORRadio Industries, Inc., Opelika, Ala. (103)

Semiconductor application notes. Two bulletins, "The use of silicon junction diodes to protect sensitive current devices" and "The use of zener power regulators as vacuum tube heater voltage stabilizers" have been published by Hoffman Electronics Corp., Evanston, Ill. (104)

Tellurium copper, a versatile, easily formed, free-machining, highly conductive copper. Ten page brochure, Noranda Copper and Brass Ltd., Montreal. (105)

Gain variations in an output rate stabilized servomechanism. IRE paper CP 58-13 by E. G. Trunk, Servo Corp. available without charge. Measurement Engineering Ltd., Arnprior, Ont. (106)



Introduction to printed circuits, by R. L. Swiggett, vice-president of Photocircuits Corp., has been published by John F. Rider Publisher. Illustrated 101 page book covers field of printed wiring. (107)

Infrared developments in military weapons systems and industrial controls is detailed in 16-page Servo Corp. report. Measurement Engineering Ltd., Arnprior, Ont. (108)

The exciting story of nickel is a 30-page illustrated booklet on Canada's nickel industry. The International Nickel Co. of Canada, Toronto. (109)

Flight simulator comprised of a 3-axis table and analogue computer for testing test missiles, aircraft navigational systems and components, is described in Bendix 24-page bulletin. Computing Devices of Canada Ltd., Ottawa. (110)

High frequency transistors. Ratings, characteristics, and features are contained in 12-page brochure G-150. General Transistor Corp., Jamaica, N.Y. (111)

Pulse code generators for design and test of memory components and digital logic. Four-page catalogue describes the 5100A series. Electro-Pulse, Inc., Culver City, Calif. (112)

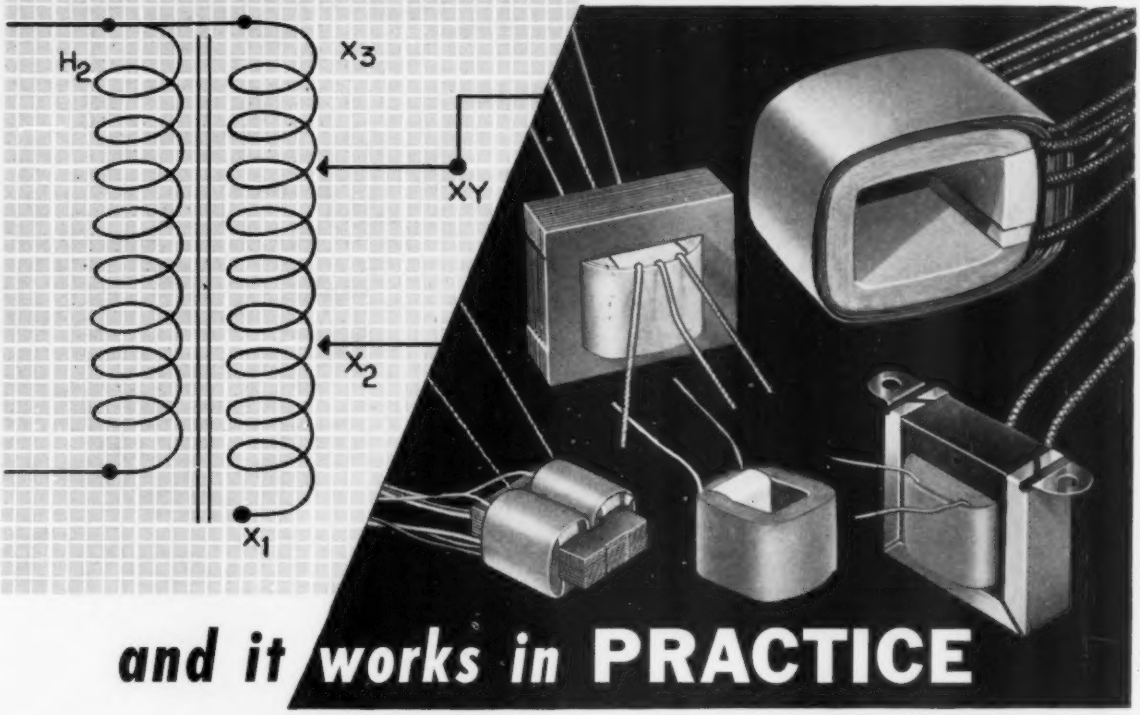
Industrial fasteners of die cast zinc alloy and molded nylon are described in 8-page catalogue. Gries Reproducer Corp., New Rochelle, N.Y. (113)

Soldering irons and case histories of operating costs are the subject of bulletin GED-3553. Canadian General Electric Co. Ltd., Toronto. (114)

BOOK REVIEWERS

Readers interested in reviewing technical books for this department of Canadian Electronics Engineering are invited to write to the Editor. Letters should list subjects that could be undertaken, with details of qualifications. Names will be retained for our future reference.

It looks good in THEORY...



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Circle No. 25 on Reader Service Card

New products

Pulse code generators for study and test of memory components

Designed for study and test of memory components and digital logic, Electro-Pulse 5100A Series Pulse Code Generators provide high speed pulse programs at high impedance and high power output.

Single and multiple channel 10 bit pulse codes are provided at clock rates to one megacycle, with controllable repeat of selected intervals. Output from each channel is variable from 50 ma to five amp peak current, with rise and fall time control provided. Multiple channel outputs, positive and negative around ground, may be paralleled for high pulse current or the formation of complex codes.

Instruments are comprised of various combinations of coding units and output amplifiers (current drivers). Amplifiers are self-contained, with integral power supply, and may be driven by any general-purpose pulse generator.

Electro-Pulse, Inc., Culver City, Calif. (115)

Mutual conductance tube tester

One feature of the model 8-77 portable tube tester is the socket design consisting of a snap-in master socket panel, easily removed to expose the type 11 pin socket. This will accommodate other socket panels or adapters for checking foreign or older style tubes.

Other features include a shortstest consisting of five neon lights which automatically indicate a short or leakage between elements and identify which elements are shorted. By depressing one push button, grid current due to gas content is measured on the meter. A reserve cathode capacity test is also provided to indicate when the tube is nearing the end of its useful life.

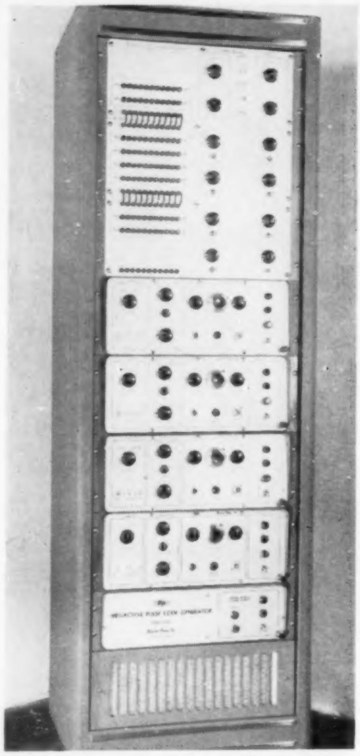
Scales on the 100-microampere 5-in. meter provide direct reading in microohms in three ranges to 15,000 microohms. Filament voltage is in 18 steps from 0.6 to 117 volts. Power requirements are 105-120 volts 60 cps, 40 watts.

Stark Electronic Instruments Ltd., Ajax, Ontario. (116)

Four speed radio phonograph

The series HRC29 console radio phonograph incorporates Collaro "Conquest" four speed record changer. It plays 7, 10 and 12-in. records at all speeds, 78, 45, 33 1/3 and 16 rpm. It will play mixed record sizes provided they are stacked according to size. Two speakers, a 10-in. woofer and a 3½-in. tweeter, with a crossover network are incorporated in the Console. The radio tuner is a-m.

Canadian Admiral Corporation Ltd., Port Credit, Ont. (117)



Direct reading attachment converts spectrograph for production control

A direct reading attachment permits the Baird-Atomic 3-meter grating spectrograph to be used for routine control as well as research studies. An automatic servo monitor compensates for environmental variations to give constant, precise optical alignment. The position of spectrum lines can be maintained to two or three microns. This monitor corrects angular deviations of less than ¼ second of an arc.

An electronic slit setting attachment permits the direct reading attachment to be realigned to eight different elements in less than one hour. It provides for separate movement of the top and bottom of exit slit onto an oscillating spectrum line and the movement of this slit onto the line is monitored by an oscilloscope. An exit slit can be accurately set on a line in less than five minutes.

Interchangeable with the standard camera is the phototube assembly which translates the spectral image intensity to a dial readout. It consists of 10 exit slits mounted on a focal curve, each with a corresponding photo multiplier tube; one tube is required for the automatic servo monitor, another as an internal standard. The percent concentration is read directly from a logarithmic scale on a dial when the phototube output is presented to the measuring system.

Radionics Ltd., Montreal. (118)

Variable reluctance cartridge

Push-pull arrangement of the cartridge coils in the Goldring "600" variable reluctance cartridge helps to eliminate hum voltage through cancellation. There are two main air gaps in the magnetic circuit with a micro-cantilever armature in each gap carrying a carefully mounted jewel tip. These are normally diamond for L.P. records and sapphire for standard groove records. By reducing dynamic mass, transient response has been improved over the "500" cartridge. This takes the high frequency response beyond 21,000 cps.

The cartridge bracket will fit all standard arms and shelves having ½-in. fixing centres.

Musimart of Canada Limited, Montreal. (119)

Teflon stock shapes

Various stock shapes of Teflon are available for use in fabricating electronic equipment and making specialized parts. The stock items available are rods, tubing, tape, sheets and spaghetti in various sizes.

Peckover's Ltd., Toronto. (120)

Precision temperature controls

Meltrol model TC-1 temperature control unit uses a thermistor type probe which may be located several feet from the control unit. Sensitivity is better than ±0.25 C and the coarse and fine controls may be mounted remotely. Temperature ranges from 0 C to 500 C are available.

The units are housed in steel cases with standard conduit knock-outs. The relay has dpdt contacts rated at 10 amperes (non inductive) at 115 volts. Operation is from either 115 v or 230 v, 60 cps using an internal isolation transformer.

Measurement Engineering Ltd., Arnprior, Ont. (121)

(Continued on page 45)

New products — cont.

Frequency bridge

The Wien bridge circuit is employed in model D101-C frequency bridge to measure audio frequencies in the range 100 cps to 12,100 cps. Measurements to an accuracy of ±0.25% are possible by means of two decade dials and a continuously variable direct reading dial which covers the interval between adjacent steps on the second decade. Reading accuracy is better than 0.05%. The bridge is assembled on a standard 10-in. panel and connections are made to three-point jacks or standard terminal posts.

Telephones are suitable for detecting balance at audio frequencies; for lower input voltages and frequencies outside the audio range an amplifier can be supplied.

Muirhead Instruments Ltd., Stratford, Ont. (122)

Instruments for testing servo systems

Three new instruments have been added to the Solartron servo test equipment. These include the transfer function analyzer OS10/VP253 Mk II which has the following improvements over the Mk I analyzer. Improved accuracy at the lower frequencies in both amplitude and phase has been achieved. Printed circuits have reduced physical size and the input impedance is now 10 megohms.

Transfer function reference resolver JX.746 is useful in making allowance for phase shifts in transducers or to give direct R_0 presentation. It gives simultaneous identical phase shift to each phase of a four-phase reference signal. The phase is shifted in discreet steps of 10 deg and 1 deg by internal automatic selector switches.

Gyro response test console JX.747 consists of the transfer function analyzer with a number of other instruments to measure transfer function and damping characteristics of rate gyros. It discriminates in favor of the fundamental frequency to give accurate readings irrespective of harmonics and unmasked by irrelevant oscillations.

Computing Devices of Canada Ltd., Ottawa. (123)

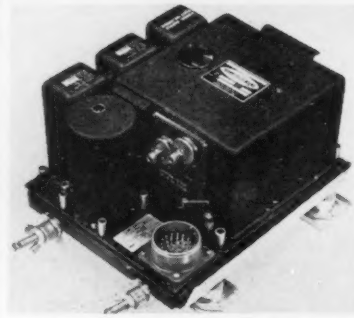
True RMS VTVM

Trio model 120-1 true rms vtvm measures 0.002 to 500 rms volts with an accuracy of ¼% of full scale, utilizing a laboratory standard edgewise-mounted meter with 7-inch mirror scale. Input impedance is 10 megohms and frequency response is 50-2,000 cps. Meter deflection is directly proportional to the square of the current through the dynamometer movement. A multi-stage, high gain amplifier converts the signal voltage into a current sufficiently powerful to drive the dynamometer movement.

Tecneek Associates, Montreal. (124)

(Continued on page 46)

True airspeed computer



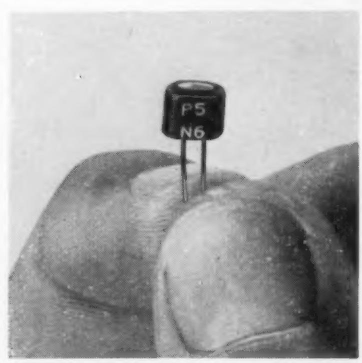
True airspeed computer Type AXC 529 has been designed to provide true airspeed input to airborne navigational systems with an accuracy of ±2 knots in a range of 100 to 250 knots. Accuracy is obtained through use of a force balance Mach number transducer which generates a shaft position functionally proportional to Mach number. Modular construction is used to simplify maintenance and reduce down-time.

Servomechanisms (Canada) Ltd., Toronto. (125)

Germanium photodiode has integral lens

The integral lens of this germanium photodiode concentrates light on the sensitive portion of the junction area. It can be used in either the visible or infra-red portions of the spectrum and was designed for use in such applications as punched card or tape reading in control systems and motion picture sound pickup.

Sensitivity of the new Germanium Photodiode is approximately 30 ma/lumen at an ambient temperature of 20 C. (Operation is to a maximum ambient temperature of 50 C.) Dark current is less than 3.5 microamperes.



Nucleonic Products Company, Inc., Los Angeles. (126)

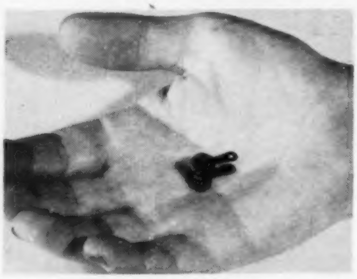
(Continued on page 47)

New products — cont.

Precision wire resistors

Ultronic precision wire-wound resistors are available in values from 1 ohm to 20 megohms. They are supplied with axial or radial leads or with solder lugs. Lug types incorporate a brass or monel tube through the centre of the resistor to provide secure mounting without affecting resistance value.

The resistors are made up of multiple pi reversed windings substantially non-inductive up to 50 kc. They are wound on bobbins compression molded of Plaskon alkyd #417 putty with external leads in place to assure firm anchorage.

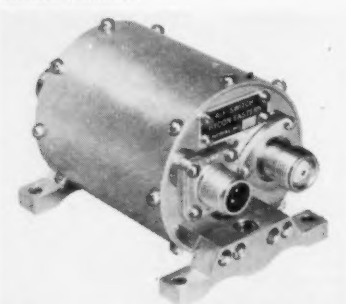


Ultronix, San Mateo, Calif. (127)

High power rf switch

Type 1696 rf switch has been designed to withstand severe environmental conditions in missiles and aircraft, but may also be used in ground applications. It will switch a transmitter from one antenna to another at high power levels (i.e. under power) without mismatching the transmitter.

Specifications are: shock up to 100 G; vibration 20 G at frequencies up to 2000 cps; temperature —40 F to +250 F; altitude unlimited because unit is pressurized; frequency range 215 to 250 mc; attenuation 0.25db max; power rating 100 watts rf cw; vswr 1.2 max; switching 0.15 sec. average; size approximately 2½ in. diameter and 4½ in. long; weight 2 lbs; actuating power 6 watts dc; cross talk 27 db down into unused channel.



Hycon Eastern, Inc., Cambridge, Mass. (128)

(Continued on page 48)

New products — cont.

Electronic sentry

An electronic signaling unit is available to telephone companies for installation in plants, factories, offices, etc., to report abnormal conditions. The Electronic Sentry, when actuated by ordinary detection devices such as thermostats, intruder alarms, etc., automatically connects itself to a telephone line, dials the prearranged number, reports what the trouble is and where it is located. It also repeats the message and will continue repeating the call if the abnormal condition is not corrected within a given time. The instrument is intended to be used on a rental basis from telephone companies.

Automatic Electric Sales (Canada) Ltd., Toronto. (129)

Computing transfer oscillator

Model 7580 computing transfer oscillator measures cw and pulsed frequencies without manual calculations using the harmonic multiplying factor. It extends the range of Beckman/Berkeley 10 mc Eput meters to beyond 12 kmc. Accuracies are up to 3 parts in 10^7. A nomograph mechanism determines and displays the harmonic number of the fundamental at zero-beat against the unknown. The harmonic number is preset into two built-in decimal counting units which scale the fundamental so that the associated counter presentation is a direct-digital reading of the unknown.

Features include a built-in crystal detector, harmonic generator and tuning stubs for maintaining input sensitivity. Output of the beat frequency is available for external scope display.

Beckman/Berkeley of Canada, Toronto. (130)

(Continued on page 51)

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Transistorized tape reader

The Ferranti high speed paper tape reader type T.R.5 is a fully transistorized photo electric tape reader capable of operating at speeds up to 300 characters per sec. A simple adjustment of a guide adapts the reader for 5, 7 or 8 unit punched paper tape. Provision being made for reading all eight channels. Built-in transistor staticisers constructed as plug-in printed circuits store the eight channels of information as each character passes through the optimum reading position and memorize them until they are read out by the associated computer.

Ferranti Electric, Toronto. (131)

Portable oscillograph recorder

The Edin lightweight amplifier case and the model 8082 two-channel portable oscillograph recorder comprise a complete recording system. Available with ink or electric writing pens, the 26 lb. recorder features six interchangeable chart speeds, 100, 50, 25, 10, 5 and 2.5 mm. per sec. Model 8082 may be used with roll or pack type chart paper.

A. C. Wickman Ltd., Toronto. (132)

Want More Information

If you wish to obtain further information on any of the advertisements or editorial items appearing in this issue, please make use of our Reader Service card on pages 49 & 50

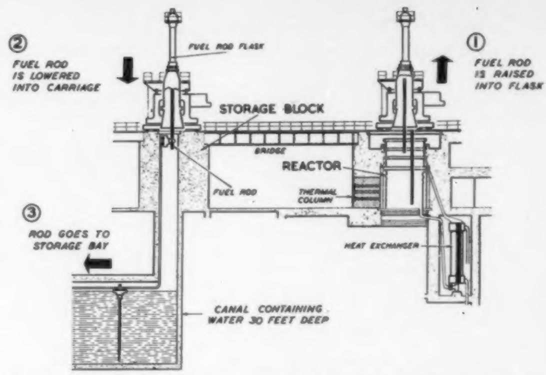
Advertisers' Index

Round-up: news and future events

NRU world's first reactor to refuel under operation

NRU reactor superintendent Gib James, working with his engineers and operators on the evening shift, made reactor history at Chalk River last month. For the first time, a spent fuel rod was extracted and a new one inserted into a reactor while it was in operation. All other reactors have to be shut down for refueling.

It was a tense moment as the operator rolled the 240 ton fueling machine over the reactor and positioned it within a tolerance of one hundredth of an inch. This was the first fully operational test.



Fuel rod must be water cooled while being lifted from the reactor and moved to canal. Some controls are electronic

Seventeen pumps went into operation as the rod was lifted up into the shielded flask. Radiation creates so much heat in the rods that they must be cooled continuously while being removed. Heavy water cools the rod, ordinary water cools the heavy water and a refrigeration system cools the ordinary water.

With the old rod up in the flask and a new fuel rod placed in the reactor, the fueling machine moved along its track to a point over a water-filled cooling-off tank. The spent fuel rod must be stored in the tank for a period of about six months to allow the radioactivity to decrease. Eventually it will be chemically processed to recover the unburned uranium and plutonium.

C.E.E. now listed in engineering index

Technical articles from Canadian Electronics Engineering are now being listed in the Engineering Index.

The index distributes daily and weekly index cards and an annual volume of abstracts to engineers, libraries, and research institutions in many countries. It is a guide to all branches of engineering information contained in approximately 1,200 technical magazines, society transactions, government bulletins, research reports, etc. Important articles in this current engineering literature are abstracted for the index.

All publications indexed are permanently filed in the Engineering Societies Library, 29 West 39th St., New York, N.Y., which will supply photoprints, microfilm or translations of the complete text of any reference supplied by the Engineering Index.

Orbitron . . what is it?

A bit of government double talk certainly hasn't brought the orbitron out from behind the security curtain. Described as an "electron tube detector-converter," this new Canadian development could be anything from a new type of tube to a radar detection-plotting system.

There is some evidence that would lead one to believe the latter is getting close to the truth. For one thing, it has been referred to as a "system," and it was developed by Adalia Ltd., a company best known for its work in the field of systems.

A new company has been set up to handle this project. It is Orbitron Development Ltd., formed by Adalia Ltd., Montreal, and Spartan Air Services of Ottawa. The new company offices will be in Montreal.

RADIO WEEK

The 148 member radio stations of the CARTB, the CBC, and Canadian radio manufacturers will be intensifying their efforts to exhort the public to "Be in the know — buy another RADIO — and LISTEN!" during the second annual Canadian Radio Week, May 4 to 10.

W. H. Jeffrey, President of The Radio-Electronics-Television Manufacturers Association of Canada recently said: "I hope that Canadian Radio Week becomes a regular date in the broadcasting calendar. It is not possible to over-emphasize to the public the important part radio plays in their lives. Radio, with its round-the-clock service, is unrivalled in keeping us informed on home and world affairs."

Lossy elements for microwave

Designing lossy microwave elements for experimental work can be an expensive, time consuming process. The final stages are generally a matter of trial and error. A new technique of casting lossy elements in resin will be described in the May issue.

Servo amplifiers are frequently required to operate at high ambient temperatures. Watch for details on how to design transistorized amplifiers that will give reliable operation in small, warm enclosures.

Third article in the series on technical writing will discuss the materials and techniques used in preparing drawings and artwork for instruction books. This information could save time and money for any drafting department.

COMING EVENTS FOR YOUR DIARY

April

14-16	AIEE-IRE-ASME Automatic Techniques Conference. Detroit, Mich.
14-17	15th Annual Radio Component Show, Grosvenor House and Park Lane House, London, W.1.
16-25	Instruments, Electronics & Automation Exhibition. Olympia, London.
22-24	AIEE - IRE - EIA - WCEMA Joint Electronic Components Conference. Los Angeles.

May

6-9	AIEE - IRE - ACM Western Joint Computer Conference. Los Angeles, Calif.
12-14	National Aeronautical & Navigational Electronics Conference. Dayton, Ohio.
19-21	Electronic Parts Distributors Show. Chicago.
19-23	International Convention on Microwave Valves. I.E.E., London W.C.2.
21-23	Engineering Institute of Canada annual meeting. Quebec.

Canadian Westinghouse
1000 watt transmitters now in operation by Royal Canadian Navy

New Canadian Westinghouse HA type transmitters now provide communications for the Royal Canadian Navy between Moncton, New Brunswick and other stations such as Gander, Newfoundland. This 1000 watt equipment designed to withstand temperature and humidity extremes meets the critical specifications of the RCN.

The same Canadian Westinghouse transmitters selected by the Navy for important communications networks are also available for commercial application. The versatile HA series comes in four models—three CW and one phone. CW types can be readily converted to phone with an easily installed modulator.

Canadian Westinghouse engineers have specified in the tube complement of the conservatively rated HA series transmitters a pair of Eimac 4-400A radial-beam power tetrodes in each of the final amplifier and modulator—CW HT swamping stages.

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